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NATIONAL PROGRAM OF INSPECTION OF NON-FEDERAL DAMS, TENNESSEE. --ETC(U)
SEP 81 G E MOORE DACW62-81-C-0056

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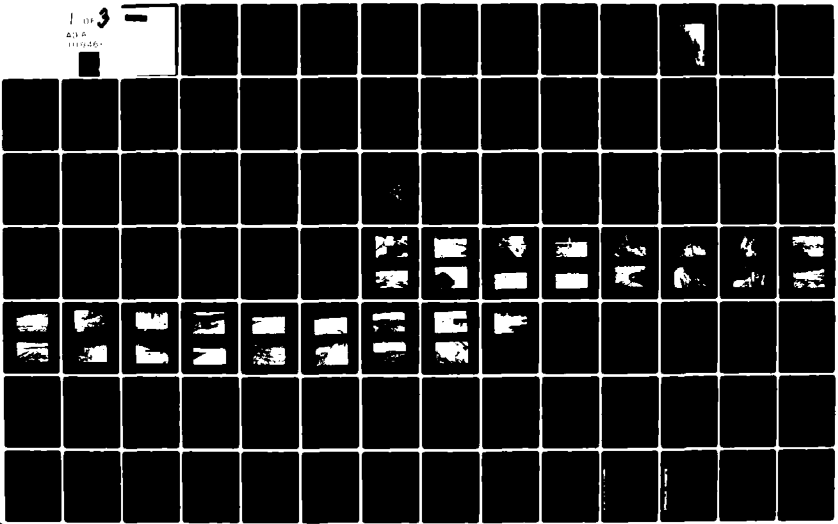

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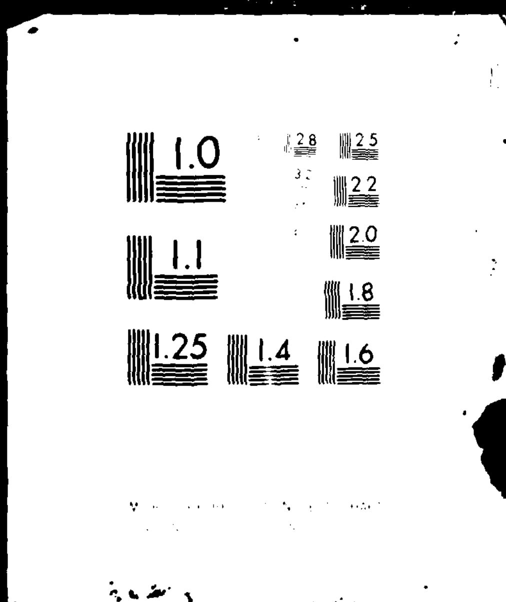

1.5 Inspection Team Members - The inspection was conducted by the following State personnel:

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Embankments
Visual Inspection
Structural Analysis

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Based on the findings of a Phase I inspection of Spring Lake and Old Hickory Lake Dams in Hardeman County: Spring and Old Hickory Lake Dams are in series w with each other and with Chancellor Dam upstream. The dams are of similar construction and have the same owner. Spring Lake Dam is a zoned earthfill embankment 21.5 feet high and 400 feet long with a crest width of 12 feet. The side slopes are 3H:1V upstream and 3.7H:1V downstream. The service spillway is a concrete riser with two 1' x r' openings leading to a 15 inch concrete pipe passing under the dam. The drawdown drain is a 15 inch diameter gate

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valve at the base of the riser. The emergency spillway is a trapezoidal earth saddle on the right abutment with an estimated capacity of 3500 cfs. Old Hickory Dam is a zoned earthfill embankment 20.5 feet high and 530 feet long with a crest width of 12 feet. The side slopes are 3.5H:1V upstream and 3.9H: 1V downstream. The service spillway is a concrete riser with two 1' x 4' openings leading to a 24 inch concrete pipe passing under the dam. The draw-down drain is a 24 inch gate valve at the base of the riser. The emergency spillway is a trapezoidal earth saddle on the left abutment with an estimated capacity of 4670 cfs. Both dams are in the samll size high hazard potential categories. Neither dam shows any overt signs of instability. The vegetative cover of the dams is very poor and erosion is occurring on the embankments and in the spillways. Some evidence of dispersive soils were found. Minor amounts of seepage were found below each dam, but there were no indications of the transport of embankment material. The storage/spillway capacity of the dams is considered to be adequate. The full PMF will pass the structures without overtopping if the Chancellor Dam upstream of Spring passes the PMF Safely. Considering a breach of Chancellor Dam during the 1/2 PMF, the Spring Lake Dam will be overtopped. Old Hickory Lake Dam will pass the flow even if a breach of Spring is considered. Because of these findings, Spring Lake and Old Hickory Lake Dams are considered to be deficient.

Accession For

A

DEPARTMENT OF THE ARMY
NASHVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1070
NASHVILLE, TENNESSEE 37202

21 SEP [illegible]

IN REPLY REFER TO
ORNED-G

Honorable Lamar Alexander
Governor of Tennessee
Nashville, TN 37219

Dear Governor Alexander:

Furnished herewith is the Phase I Investigation Report on Spring Lake and Old Hickory Dams near Saulsbury, Tennessee. The report was prepared under the authority and provisions of PL 92-367, the National Dam Inspection Act, dated 8 August 1972.

The report presents details of the field inspection, background information, technical analyses, findings, and recommendations for improving the condition of the dams.

Based upon the inspection and subsequent evaluation, Spring Lake and Old Hickory Dams are classified as deficient due to minor erosion that is occurring on the embankments and in the emergency spillways, and some seepage present on the downstream toes of the dams.

The recommendation concerning repair and stabilization of the slopes against further erosion contained in this report should be undertaken in the near future.

Public release of the report and initiation of public statements fall within your prerogative. However, under provisions of the Freedom of Information Act, the Corps of Engineers is required to respond fully to inquiries on information contained in the report and to make it accessible for review on request.

Your assistance in keeping me informed of any further developments will be appreciated.

Sincerely,

[signature], LTC

FOR LEE W. TUCKER
Colonel, Corps of Engineers
Commander

1 Incl
As stated

CF:
Mr. Robert A. Hunt, Director
Division of Water Resources
4721 Trousdale Drive
Nashville, TN 37220

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dams .... Spring Lake
Old Hickory

County .... Hardeman

Stream .... Unnamed trib. of
E. Fork of Spring Creek

Date of Inspection .... March 10, 1981

Prepared By:

George E. Moore
Regional Engineer

Approved By:

Edmond B. O'Neill
Chief Engineer
Safe Dams Section

Approved By:

Robert A. Hunt, P.E.
Director, Division of
Water Resources
Tennessee Department
of Conservation

PREFACE

This report is prepared under guidance contained in the Department of the Army, Office of the Chief of Engineers, Recommended Guidelines for Safety Inspection of Dams, for a Phase I investigation. The purpose of the Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In the review of this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. Additional data or data furnished containing incorrect information could alter the findings of this report. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structures and may obscure certain conditions which might be detectable if inspected under the normal operating environment of the structure.

The analyses and recommendations included in this report are related to the hazard classification of the structure at the time of the report. Changes in conditions downstream of the dam may change the hazard classification of the structure. A change in hazard classification may in turn change the design flood on which the hydraulic and hydrologic analyses are based and may have a significant impact on the assessment of the safety of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions and is evolutionary in nature. It would be incorrect to assume that the present conditions of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspections can there be any chance that unsafe conditions will be detected.

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3 - Chancellor

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dams .... Spring Lake
Old Hickory

County .... Hardeman

Stream .... Unnamed Trib. of
E. Fork of Spring Creek

Date of Inspection .... March 10, 1981

ABSTRACT

This report is based on the findings of a Phase 1 inspection of Spring Lake and Old Hickory Lake Dams in Hardeman County. Spring and Old Hickory Dams are in series with each other and with Chancellor Dam upstream. The dams are of similar construction and have the same owner.

Spring Lake Dam is a zoned earthfill embankment 21.5 feet high and 400 feet long with a crest width of 12 feet. The side slopes are 3H:1V upstream and 3.7H:1V downstream. The service spillway is a concrete riser with two 1' x 4' openings leading to a 15 inch concrete pipe passing under the dam. The drawdown drain is a 15 inch diameter gate valve at the base of the riser. The emergency spillway is a trapezoidal earth saddle on the right abutment with an estimated capacity of 3500 cfs.

Old Hickory Dam is a zoned earthfill embankment 20.5 feet high and 530 feet long with a crest width of 12 feet. The side slopes are 3.5H:1V upstream and 3.9H:1V downstream. The service spillway is a concrete riser with two 1' x 4' openings leading to a 24 inch concrete pipe passing under the dam. The drawdown drain is a 24 inch gate valve at the base of the riser. The emergency spillway is a trapezoidal earth saddle on the left abutment with an estimated capacity of 4670 cfs.

Both dams are in the small size, high hazard potential categories. Neither dam shows any overt signs of instability. The vegetative cover of the dams is very poor and erosion is occurring on the embankments and in the spillways. Some evidence of dispersive soils were found. Minor amounts of seepage were found below each dam, but there were no indications of the transport of embankment material. The storage/spillway capacity of the dams is considered to be

adequate. The full PMF will pass the structures without overtopping if the Chancellor Dam upstream of Spring passes the PMF safely. Considering a breach of Chancellor Dam during the ½ PMF, the Spring Lake Dam will be overtopped. Old Hickory Lake Dam will pass the flow even if a breach of Spring is considered. Because of these findings, Spring Lake and Old Hickory Lake Dams are considered to be deficient.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
SPRING LAKE DAM
OLD HICKORY LAKE DAM
HARDEMAN COUNTY, TENNESSEE

SECTION 1 - GENERAL

1.1 Authority - The Phase I inspection of this dam was carried out under the authority of Tennessee Code Annotated, Sections 70-2501 to 70-2530, The Safe Dams Act of 1973, and in cooperation with the U. S. Army Corps of Engineers under the authority of Public Law 92-367, The National Dam Inspection Act.

1.2 Purpose and Scope - The purpose of a Phase I investigation is to develop an engineering assessment of the general condition of a dam with respect to safety and stability. This is accomplished by conducting a visual inspection; reviewing any available design and construction data; and performing appropriate hydraulic, hydrologic, and other analyses. A comprehensive description of the Phase I investigation program is given in Recommended Guidelines for Safety Inspection of Dams, Department of the Army, Chief of Engineers, Washington, D. C. 20314.

1.3 Past Inspections - Past inspections of Spring Lake and Old Hickory Lake Dams include cursory inspections by George Moore and Troy Wedekind of the Tennessee Division of Water Resources on February 14, 1979. At this time, moderately severe erosion was occurring in the emergency spillway and on the left downstream embankment abutment contact on Spring and minor erosion was occurring on the downstream slope of Old Hickory. The flap gates on the toe drains on Spring Lake were sticking and water was backing up behind them. A small spring or seep was located at the toe on the right end of Old Hickory Dam. Several inspections were made during the construction of the dams by Ed O'Neill, also of the Tennessee Division of Water Resources.

1.4 Miscellaneous Details - The day of the inspection was clear with an ambient temperature of about 60°F.

1.5 Inspection Team Members - The inspection was conducted by the following State personnel:

Ed O'Neill, Chief Engineer
George Moore, Regional Engineer
Bill Culbert, Water Resources Engineer
Anthony Privett, Engineering Co-op

SECTION 2 - PROJECT DESCRIPTION

2.1 Location - The projects are located in Hardeman County, Tennessee, about 4 miles east of Saulsbury, Tennessee. The dams are located on the Saulsbury topographic quadrangle (432SE) with Old Hickory Dam at 89°01'37" west longitude and 35°02'31" north latitude and Spring Lake Dam at 89°01'15" west longitude and 35°02'17" north latitude. Spring Lake Dam is located about 2500' upstream of Old Hickory Dam at the headwaters of the reservoir. Old Hickory Dam intercepts an unnamed tributary about 0.5 miles from the east fork of Spring Creek. The east fork of Spring Creek flows 6 miles to its confluence with several other streams to form the mainstem of Spring Creek.

2.2 Description: Spring Lake Dam

2.2.1 Embankment - The Spring Lake Dam is an earth embankment dam with a straight alignment. The maximum height is 19.4 feet (21.5 feet on the design plans) and the length is 460 feet (400 feet). The crest width is 12 feet. The upstream slope is about 3H:1V from the water surface to the top of the dam. The downstream slope is about 3.7H:1V (3H:1V). The slopes have a moderately good grass cover but no upstream wave protection. The dam site is located in the Claiborne and Wilcox formations of the Mississippi embayment sediments. These are irregularly bedded sands of the Tertiary Period locally interbedded with lenses and beds of gray and white clays, silty clays, lignitic clay, and lignite.

2.2.2 Service Spillway - The service spillway is a 2.5' x 4' skirted concrete riser with two 1' x 4' inlets at the water surface. The riser leads to a 15" ID concrete pipe which passes under the dam. The inlet elevation of the spillway is about 521' msl and the invert of the pipe outlet is 510.9' msl (509.5' msl). The maximum capacity of the spillway is 21 cfs.

2.2.3 Drawdown Drain - The drawdown drain is a 15" slide gate at the base of the riser. The invert elevation is 513' msl.

2.2.4 Emergency Spillway - The emergency spillway is an unlined earth saddle on the right abutment. The control section has a base of 30'. The left side slope rises at 11H:1V for 1.3 feet and increases to 3.4H:1V to the top of the dam elevation. The right side slope rises at 21H:1V for 2.5 feet and increases to 3H:1V to the top of the dam elevation. The maximum depth in the spillway is 5.2 feet which gives an outflow of about 3500 cfs. The design plans call for a trapezoidal control section with a base width of 100' and 3H:1V side slopes.

2.2.5 Reservoir and Drainage Area - The reservoir has a surface area of 11 acres and a fetch of 1100'. The normal impounding capacity of the reservoir is estimated to be 57.2 acre-feet with about 140 acre-feet of flood storage above normal pool. Forty acres of the drainage area is controlled by Chancellor Dam (TN06939). The uncontrolled area is about 147 acres giving a total drainage area of 187 acres. The uncontrolled area has a reach of about 2000 feet and a maximum relief of about 120 feet. The predominant soil groups are Ruston, Lexington, and Providence and the primary use is medium density residential development.

2.3 Description: Old Hickory Lake Dam

2.3.1 Embankment - The Old Hickory Lake Dam is an earth embankment dam with a straight alignment. The maximum height is 20.5 feet and the length is 595 feet (630 feet on the design plans). The crest width is 11 feet (12 feet). The upstream slope is 3.5H:1V (3H:1V) from the water surface to the crest. The downstream slope is about 3.9H:1V (3H:1V). The geologic setting is the same as for Spring Lake Dam. Sketches are provided in Appendix B.

2.3.2 Service Spillway - The service spillway is a 2.5' x 4' skirted concrete riser with two 1' x 4' inlets at the water surface. The riser leads to a 24" ID concrete pipe which passes under the dam. The inlet elevation of the spillway is about 504' msl and the invert of the pipe outlet is 490.5' msl. The maximum capacity of the spillway is 21 cfs.

2.3.3 Drawdown Drain - The drawdown drain is a 24" slide gate at the base of the service spillway riser. The invert elevation is 496' msl.

2.3.4 Emergency Spillway - The emergency spillway is an uncontrolled earth saddle on the left abutment. The control section is approximately trapezoidal with a base of 130 feet and side slopes of 3.3H:1V on the right and 3H:1V on the left. The base of the spillway is slightly elevated on the left side. The design plans call for the control section to have a 100' wide level base and 3H:1V slopes on each side.

2.3.5 Reservoir and Drainage Area - The reservoir has a surface area of about 28 acres and a fetch of about 1200 feet. The normal capacity of the reservoir is estimated to be about 153 acre-feet with about 220 acre-feet of flood storage above normal pool. Spring Lake Dam controls 187 acres of the drainage area. The uncontrolled area is 167 acres giving a total drainage area of 354 acres. The uncontrolled area has a reach of about 1300 feet and maximum relief of 120 feet. The predominant soil groups are Ruston, Lexington, and Providence and the primary use is medium density residential development.

2.4 Downstream Hazard Potential - Spring Lake and Old Hickory Lake Dams have been assigned a downstream hazard potential classification of high. The stream leading from Old Hickory Dam passes through a portion of the Candlewood subdivision. Two lots in the downstream area are occupied and several others are in various stages of development. The stream also crosses a mainline of Southern Railway and State Hwy 57. Spring Lake Dam is immediately upstream of Old Hickory Lake.

2.5 Miscellaneous - The dams are currently owned by the Candlewood Lakes Property Owner's Association (W. J. Arnold, President). The dams were built in 1976 as recreational lakes for the Candlewood Subdivision being developed by Terra Aqua Corporation. The dams were designed by Ragon Engineering Company with soils testing subcontracted to Construction Materials Lab, Inc. The construction was performed by S & W Construction Company. No major repairs have been reported since construction. Certificates of Operation were issued by the State in 1977. Ownership of the dams was turned over to the Property Owner's Association in 1979. No instrumentation was found on either dam.

SECTION 3 - FINDINGS

3.1 Visual Inspection - Spring Lake Dam

3.1.1 Embankment - The upstream slope of the dam is in good condition with a fair covering of grass. A berm at the water surface is the only wave protection and some minor sloughing has occurred (photo no. 2). The crest has almost no cover but appears to be in good condition. Vehicular traffic has been restricted from the crest. The downstream slope is eroding and in some areas the erosion is becoming significant. Jug holes indicative of dispersive soils were found in some areas (photo nos. 4-8). Minor erosion is also occurring along the embankment abutment contacts (photo nos. 19 & 20). A hand auger sample of the embankment material is a clayey sand of group SC in the Unified Classification System.

The flapgates on the toe drain outlets were stuck closed and the left drain had backed up a considerable amount of water (photo nos. 12 & 13). Some sediment was visible in the flow from the left drain after the gate was opened (photo no. 14). The toe of the embankment was damp below the level of the toe drain and a saturated area with swamp grass was located about 30 feet left of the service spillway.

3.1.2 Service Spillway - A thorough inspection of the service spillway system could not be made but the visible portions of the spillway appeared in generally good condition. A few cracked spots were found on the outlet of the pipe. A small depression was found in the fill above the pipe near the toe of the embankment. It could not be determined if the depression was related to the spillway (photo nos. 9-11).

3.1.3 Emergency Spillway - The emergency spillway has almost no protective grass covering and erosion has occurred on both the side slopes and in the base of the channel (photo nos. 15-18).

3.1.4 Drawdown Drain - The drawdown drain was not operated during the inspection and no information indicating the last date of operation could be located. The lift wheel was on the lift stem (photo no. 10).

3.1.4 The right side of the emergency spillway control section is formed by embankment fill material. The fill has a narrow crest (15') and would probably erode rapidly under high stage flows (photo no. 15).

3.1.5 The service spillway is a concrete culvert pipe passing through the embankment above the water level at the time of the inspection. The pipe joint was open about 1 inch. The pipe has a headwall on each end. Fill does not completely cover the pipe. Flow from the pipe drops into a small concrete chute. The maximum capacity of the chute is less than 3 cfs while the maximum capacity of the pipe is about 48 cfs. The flow will, therefore, overflow the chute and impinge upon the embankment (photo nos. 7-11).

3.1.6 According to OCE guidelines, the dam is in the small size and high hazard potential classifications. As such, the structure is required to pass the one-half to the full probable maximum flood (PMF). The volume of inflow during the PMF is 83.7 acre-feet. Analysis indicates that the structure can pass the AMC II PMF with no freeboard. Slight overtopping will occur during the PMF under AMC III conditions. Routing of the 100-year storm produced flow of .9 feet in the emergency spillway and the ½PMF produced about 1.9 feet of flow in the emergency spillway.

3.1.7 The project is located in Seismic Zone 2.

3.1.8 This dam is in the high hazard potential classification as outlined in the OCE guidelines. Failure of the dam could affect two house trailers and Spring and Old Hickory Dams which are also considered high hazard. During the ½ PMF, Spring Lake Dam would be expected to fail but the storm will be contained by Old Hickory Dam. However, an excessive loading of silt and debris would occur.

3.1.9 The measured configuration of the dam differs markedly from the design plans. The longitudinal alignment of the dam has been changed from linear to sinusoidal. Plans call for 1V:3H side slopes but the measured slopes are 1V:2.4H upstream and 1V:2.3H downstream. The designed emergency spillway is a trapezoidal channel cut

3.1.5 Downstream Channel - The spillways empty almost directly into the Old Hickory Lake (photo no. 22).

3.1.6 Reservoir and Drainage Area - No indications of excessive sedimentation were seen. The water has high turbidity. Development of the drainage area is continuing with the entire area being planned for 1/3 acre residential lots.

3.2 Visual Inspection - Old Hickory Lake Dam

3.2.1 Embankment - The upstream slope is in generally good condition. Minor erosion is occurring along the water surface. One small jug hole was found near the right end of the dam on the upstream slope. The grass cover of the upstream slope is moderate to poor. The crest has almost no cover. Several small depressions, about 2 feet in diameter and 6 inches deep, were located on the downstream edge of the crest (photo no. 24).

Erosion is occurring on the lower portion of the downstream slope with some 2 to 3 feet deep gullies. Representatives of the owner stated that repairs have been required on the downstream slope because of erosion. The lower 1/2 to 2/3 of the slope is muddy probably due to water being retained in poorly compacted fill in repaired areas. Several pockets of mud up to 3 feet deep were found. Jug holes, indicative of dispersive soils, were seen in some areas of the slope (photo nos. 25-28). A hand auger sample of the embankment material is silty sandy clay of group CL in the Unified Classification System.

The left toe drain was carrying a very slight flow (less than .5 gpm) and the right toe drain had no flow. Dry sediment has collected in the invert of the right toe drain (photo no. 32).

3.2.2 Service Spillway - A thorough inspection of the service spillway could not be made, but the visible portions appeared to be in good condition. Some minor erosion has occurred in the fill around the pipe near the outlet (photo no. 31).

3.2.3 Emergency Spillway - The emergency spillway has almost no protective grass covering. Some erosion has occurred on the slopes and in the base but the erosion is generally minor (photo nos. 29 & 30).

3.2.4 Drawdown Drain - The drawdown drain was not operated during the inspection and no records indicating its last usage were available.

3.2.5 Downstream Channel - The downstream channel appeared to be in good condition with no accumulated debris or obstructions (photo no. 33).

3.2.6 Reservoir and Drainage Area - No indications of excessive sedimentation were seen. The water has moderately high turbidity with a brownish green color and visibility of about 1 foot. Development of the drainage area is continuing with the entire area being planned as 1/3 acre residential lots.

3.3 Review of Data - Design plans were provided by James H. Ragon and are included in Appendix G of this report.

The crest elevation of Spring Lake Dam appears to be about 1 foot less than specified on the plans. The emergency spillway has been deformed somewhat by the washing of material from the side slopes into the base of the channel, but it appears that the originally constructed channel probably was not the full 100 foot width specified on the plans.

The only variations from the design plans on Old Hickory are more conservative than the original design. The embankment slopes are less than specified and the emergency spillway is 30 feet wider than on the plans.

Except as stated, the dams appear to be in substantial compliance with the design plans.

3.4 Static and Seismic Stability - The stability of the dams was not analyzed due to the lack of appropriate engineering data. Visual assessment and engineering judgment indicate a stable structure due to the moderate slopes and only minor amounts of seepage;

however, erosion and dispersion, if left unchecked, could eventually undermine the stability of the embankments. The dams are located in seismic zone 2.

3.5 Hydraulic and Hydrologic Analysis - According to OCE guidelines, the dams are in the small size and high hazard potential classifications. As such, the structures are required to pass the one-half to the full probable maximum flood (PMF). Outflows from Chancellor and Son Dam (TN06939) are considered in this analysis and appropriate calculations are included in Appendix E. Analysis indicates that under antecedent moisture condition II (AMC II) the dams will pass the full PMF with 1.0 feet of freeboard on Spring and 0.8 feet of freeboard on Old Hickory.

A routing of the ½ PMF (AMC II) assuming a breach of Chancellor and Son Dam was performed. The analysis indicated that the storm would overtop Spring Lake Dam. Old Hickory Dam was able to contain the storm, assuming a breach of Spring Lake Dam.

3.6 Conclusions and Recommendations

3.6.1 Conclusions

a. The dams are considered to be inadequate with respect to hydraulic and hydrologic considerations. Routing of the ½ PMF (AMC II) assuming a breach of Chancellor Dam will overtop Spring Lake Dam. The ½ PMF will pass Old Hickory Dam. The PMF (AMC III) will overtop Chancellor, Spring, and Old Hickory Dams.

Analysis indicates that if the PMF (AMC II) is passed by Chancellor Dam, Spring and Old Hickory Dams have sufficient storage/spillway capacity to pass the storm. The inadequacies of this system appear to be dependent upon Chancellor Dam. A Phase I investigation report has been written concerning Chancellor Dam and the report includes recommendations concerning remedial action on the spillways of Chancellor Dam. Therefore, no recommendations concerning the storage/spillway capacity of Spring and Old Hickory Dams are offered.

b. The cause of the pockets of mud on Old Hickory Dam could not be determined but the most probable cause is the repair of old jug holes or erosion with uncompacted fill.

c. The erosion and jugging do not appear to be a serious problem at this time. Continued neglect of this situation could allow its eventual escalation into a serious condition.

d. No overt signs of instability were observed. The seismic resistance of these structures is unknown, but under this program, dams in seismic zone 2 may be assumed adequate under seismic loading if judged adequate in static stability requirements.

e. Some seepage appears to be occurring on the downstream toe of the dams but no indications of the transport of embankment material was seen. The improper functioning of the toe drain flap gates on Spring Lake Dam could increase the possibility of surface emerging seepage on that dam.

f. Based on the above mentioned conclusions, Spring Lake and Old Hickory Lake Dams are considered to be deficient.

3.6.2 Recommendations

a. A qualified engineer should be engaged to:

1) Check the embankment soils for dispersion and, if necessary, make recommendations for treatment.

2) Repair the erosion on the embankments and in the spillways. All areas should be stabilized by a soil binding grass cover.

b. The toe drains should be checked regularly to ensure proper functioning.

c. A program of routine maintenance and periodic inspection should be established for the dams. This should include monitoring any possible areas of seepage for changes which might indicate a deterioration of the embankment.

d. An emergency action plan should be developed for notifying downstream residents in the event potentially hazardous situations arise.

SECTION 4 REVIEW BOARD FINDINGS

The Interagency Review Board for the National Program of Inspection of Non-Federal Dams met in Nashville on 9 July to examine the technical data contained in the Phase I investigation report on Spring Lake and Old Hickory Dams. The Review Board considered the information and recommended that (1) the muddy conditions that exist on the lower ½ to 2/3 of the downstream slope be described in more detail and give possible causes for this condition, (2) the consequences to Old Hickory and Spring Lake Dams should Chancellor and Son Dam fail during the ½ PMF should be included in the report, (3) the possible causes of the mud pockets should be included in the report, (4) a qualified engineer should check the embankment soils for dispersive properties, and (5) the condition classification should be changed from "significantly deficient" to "deficient". They agreed with other report conclusions and recommendations. A copy of the letter report presented by the Review Board is included in Appendix F.

APPENDIX A

DATA SUMMARY

APPENDIX A
DATA SUMMARY

A.1 Spring Lake Dam

A.1.1 Dam

A.1.1.1 Type - Zoned earthfill, linear alignment dam with a concrete pipe service spillway and drawdown drain; a vegetated earth emergency spillway.

A.1.1.2 Dimensions and Elevations - (Elevation taken from design plans. Field measurements, shown parenthetically if different from design plans, are referenced to the water surface of Old Hickory Lake.)

a. Crest length - 400' (460')
b. Crest width - 12'
c. Height - 21.5' (19.4')
d. Crest elevation - 531' msl (530.2')
e. Service spillway elevation - 521' msl
f. Emergency spillway elevation - 525' msl (524.9')
g. Embankment slope, U/S - 3H:1V
h. Embankment slope, D/S - 3H:1V (3.7H:1V)
i. Size classification - Small

A.1.1.3 Zones - (Fill material given as per unified classification system.)

a. Core material - CL
b. Core slopes (max.) - ½H:1V
c. U/S zone material - Random fill
d. D/S zone (1) material - Random fill
e. D/S zone (1) slopes (max.) - 1½H:1V
f. D/S zone (2) material - SP or SC

A.1.1.4 Cutoff Trench - (Filled as part of core.)

a. Base width - 10'
b. Side slope - 2H:1V
c. Bottom elevation - 497'

A.1.1.5 Grout Curtains - None

A.1.2. Reservoir and Drainage Area

A.1.2.1 Reservoir - (Normal pool elevation 521' msl, 10' below the effective crest of the dam.)

a. Surface area - 11 acres
b. Fetch - 1100'
c. Capacity (normal) - 57.2 acre-feet
d. Capacity (top of dam) - 197.2 acre-feet

A.1.2.2 Drainage Area

a. Size: Controlled - 40 acres
Uncontrolled - 147 acres
Total - 187 acres
b. Maximum relief - 120'
c. Soil - Ruston (B), Lexington (B), Providence (C)
d. Cover - Medium density residential
e. Runoff (P_{100}) - 65 acre-feet
f. Runoff (PMF) - 405 acre-feet

A.1.3 Outlet Structures

A.1.3.1 Drawdown Drain - (Gate valve at base of service spillway riser.)

a. Valve diameter - 15"
b. Invert elevation - 513' msl

A.1.3.2 Service Spillway - (Concrete riser connected to a concrete pipe with concrete anti-seep collars.)

a. Inlet size - 1' x 4' (2)
b. Pipe diameter - 15"
c. Pipe length - 148'
d. Gradient - 1%
e. Anti-seep collars, size - 6" x 8' x 8'
f. Anti-seep collars numbers and spacing - 5 @ 12'
g. Spillway capacity - 21 cfs

A.1.3.3 Emergency Spillway - (Trapezoidal, vegetated earth saddle on the right abutment.)

a. Base width - 100'
b. Side slope - 3V:1H
c. Control section length - 30'
d. Entrance slope - 6%
e. Exit slope - 2%

Field measurements of the emergency spillway are as follows:

f. Base width - 30'
g. Left side slope: bottom - 1V:11H
top - 1V:3.4H
h. Right side slope: bottom - 1V:21H
top - 1V:3H
i. Capacity - 3500 cfs

A.2 Old Hickory Lake Dam

A.2.1 Dam

A.2.1.1 Type - Zoned earthfill, linear alignment dam with a concrete pipe service spillway and drawdown drain and a vegetated earth emergency spillway.

A.2.1.2 Dimensions and Elevations - (Elevation taken from design plans. Field measurements, shown parenthetically if different from design plans, are referenced to TBM, 516.14' msl, in tree on left abutment.)

a. Crest length - 630' (594')
b. Crest width - 12' (11')
c. Height - 20.5'
d. Crest elevation - 511' msl
e. Service spillway elevation - 504' msl
f. Emergency spillway elevation - 505.5' msl (506')
g. Embankment slope, U/S - 1V:3H (1V:3.5H)
h. Embankment slope, D/S - 1V:3H (1V:3.9H)
i. Size classification - Small

A.2.1.3 Zones - (Fill material given as per unified classification system.)

a. Core material - CL
b. Core slopes (max.) - ½V:1H
c. U/S zone material - random fill
d. D/S zone (1) material - random fill
e. D/S zone (1) slopes (max.) - ½V:1H
f. D/S zone (2) material - SP or SC

A.2.1.4 Cutoff Trench - (Filled as part of core.)

a. Base width - 10'
b. Side slopes - 2V:1H
c. Bottom elevation - 469' msl (approx.)

A.2.1.5 Grout Curtains - None

A.2.2 Reservoir and Drainage Area

A.2.2.1 Reservoir - (Normal pool elevation 504' msl, 7' below the effective crest of the dam.)

a. Surface area - 28 acres
b. Fetch - 1200'
c. Capacity (normal) - 153 acre-feet
d. Capacity (top of dam) - 373 acre-feet

A.2.2.2 Drainage Area - (Part of area controlled by Spring Lake Dam.)

a. Size: Controlled - 187 acres
Uncontrolled - 167 acres
Total - 354 acres
b. Maximum relief - 120'
c. Soil - Ruston (B), Lexington (B), Providence (C)
d. Cover - Medium density residential
e. Runoff (P_{100}) - 125 acre-feet
f. Runoff (PMF) - 773 acre-feet

A.2.3 Outlet Structures

A.2.3.1 Drawdown Drain - (Gate valve at base of service spillway riser.)

a. Valve diameter - 24 inches
b. Invert elevation - 496' msl

A.2.3.2 Service Spillway - (Concrete riser connected to concrete pipe with concrete anti-seep collars.)

a. Inlet size - 1' x 4' (2)
b. Pipe diameter - 24"
c. Pipe length - 132'
d. Gradient - 4%
e. Anti-seep collars, size - 6" x 8' x 8'
f. Anti-seep collars numbers and spacing - 5 @ 16'
g. Spillway capacity - 20 cfs

A.2.3.3 Emergency Spillway - (Trapezoidal, vegetated earth saddle on left abutment.)

a. Base width - 100'
b. Side slopes - 1V:3H

c. Control section length - 30'
d. Entrance slope - 4.7%
e. Exit slope - 4.7%

Field measurements of the emergency spillway are as follows:

f. Base width - 130'
g. Left side slope - 1V:3H
h. Right side slope - 1V:3.3H
i. Slope of base (increasing to the left) - .5%
j. Capacity - 4670 cfs

A.3 Historical Data

A.3.1 Construction Date - 1977

A.3.2 Designer - Ragon Engineering Company
Bolivar, Tennessee

A.3.3 Soils Testing - Construction Materials
Lab, Inc., Jackson, Tennessee

A.3.4 Builder - S & W Construction Company
Memphis, Tennessee

A.3.5 Developer - Terra Aqua Corporation

A.3.6 Owner - Candlewood Lakes Property Owner's
Assn., W. J. Arnold, President

A.3.7 Previous Inspections - February 1979

A.3.8 Seismic Zone - 2

A.4 Downstream Hazard Data

A.4.1 Downstream Hazard Potential Classification

a. Corps of Engineers - High
b. State of Tennessee - 1

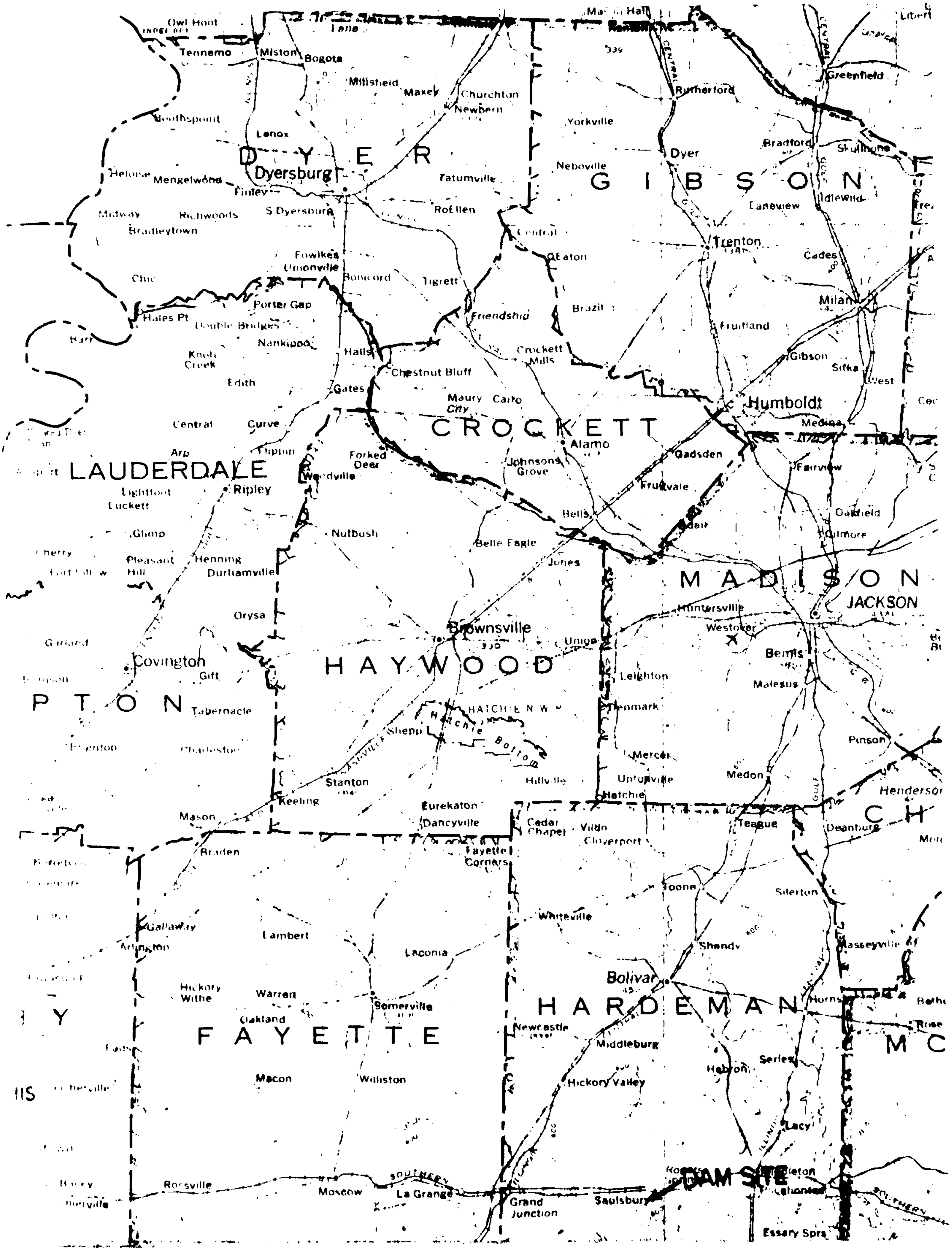
A.4.2 Persons in Probable Flood Path - Currently 0; potential of up to about 20 due to ongoing development downstream.

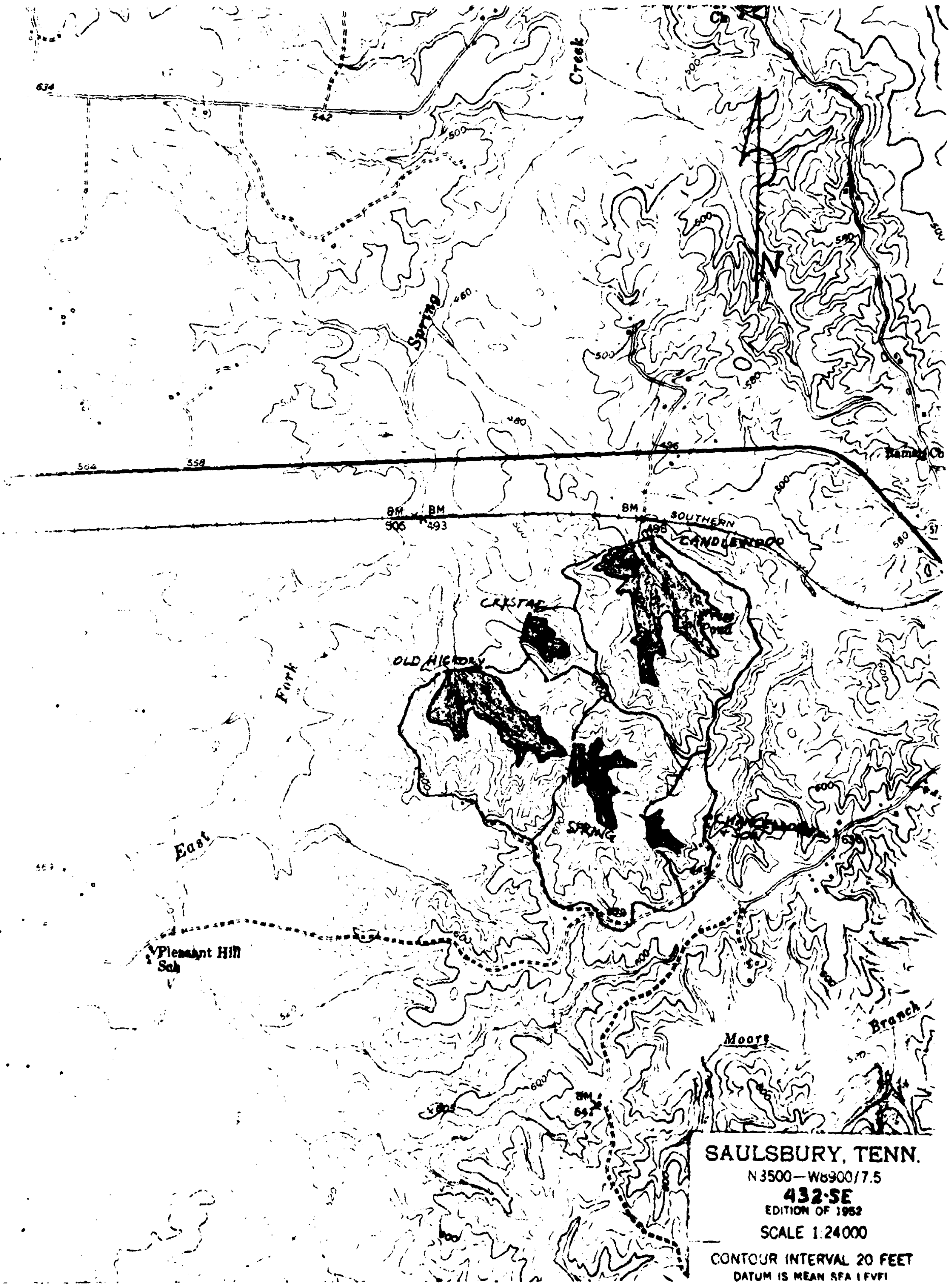
A.4.3 Downstream Property - Hwy 57, mainline Southern Railroad about .6 miles downstream

A.4.4 Warning Systems - None

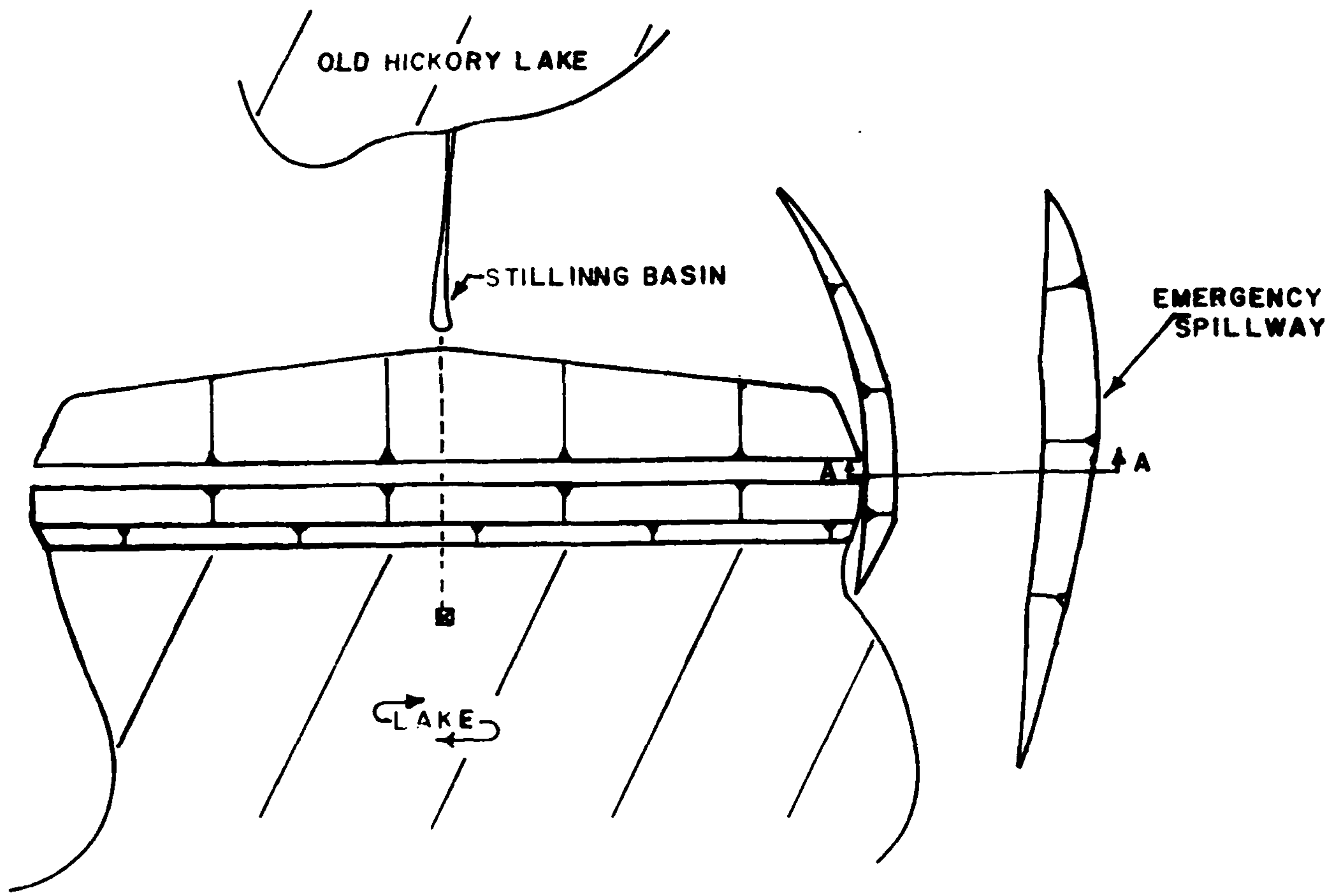
APPENDIX B

SKETCHES, LOCATION MAPS, AND DRAWINGS


DYER
GIBSON
CROCKETT
LAUDERDALE
MADISON
HAYWOOD
FAYETTE
HARDEMAN
DAM SITE
Dyersburg
Owl Hoot
Tennemo
Miston
Bogota
Millsfield
Maxey
Churchton
Newbern
Lenox
Boothspoint
Heloise
Mengelwood
Finley
S Dyersburg
Midway
Richwoods
Bradleytown
Tatumville
RoEllen
Yorkville
Neboville
Rutherford
Dyer
Bradford
Greenfield
Skullbone
Laneview
Idlewild
Trenton
Cades
Eaton
Brazil
Fruitland
Milan
Gibson
Sitka
West
Humboldt
Medina
Fowlkes
Unionville
Concord
Tigrett
Friendship
Porter Gap
Hales Pt
Double Bridges
Nankipoo
Halls
Chestnut Bluff
Crockett Mills
Knob Creek
Edith
Gates
Maury City
Cairo
Central
Curve
Alamo
Gadsden
Arp
Ripley
Forked Deer
Johnsons Grove
Woodville
Fruitvale
Lightfoot
Luckett
Bells
Fairview
Oakfield
Gilmore
Glimp
Nutbush
Belle Eagle
Jones
Pleasant Hill
Henning
Durhamville
JACKSON
Huntersville
Westover
Orysa
Brownsville
Union
Bemis
Covington
Gift
Leighton
Malesus
Tabernacle
Denmark
Charleston
Mercer
Pinson
Untonville
Medon
Stanton
Keeling
Hillville
Hatchie
Henderson
Mason
Eurekaton
Dancyville
Cedar Chapel
Vildo
Cloverport
Teague
Deanburg
Braden
Fayette Corners
Toone
Silerton
Whiteville
Gallaway
Arlington
Lambert
Laconia
Shandy
Masseyville
Bolivar
Hickory Withe
Warren
Somerville
Oakland
Newcastle
Middleburg
Hornsby
Serles
Hebron
Macon
Williston
Hickory Valley
Lacy
Rossville
Moscow
La Grange
Grand Junction
Saulsbury
Essary Sprs
HATCHIE N W R
Hatchie Bottom
SOUTHERN



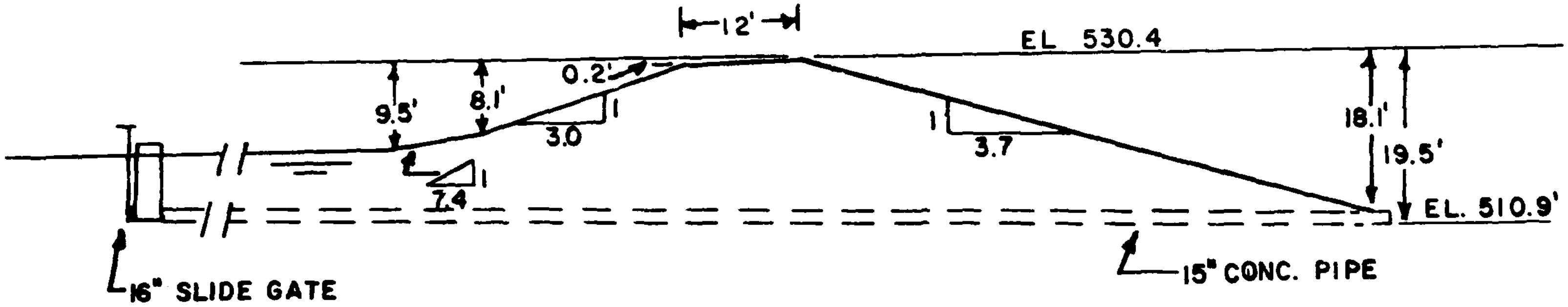
Creek
Spring
East
Fork
Pleasant Hill
Sch
SOUTHERN
CANDLEWOOD
CRYSTAL
OLD HICKORY
SPRING
Moore
Branch
BM
505
BM
493
SAULSBURY, TENN.
N3500—W8900/7.5
432-SE
EDITION OF 1952
SCALE 1:24000
CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL



GENERAL PLAN

SCALE 1" = 100'

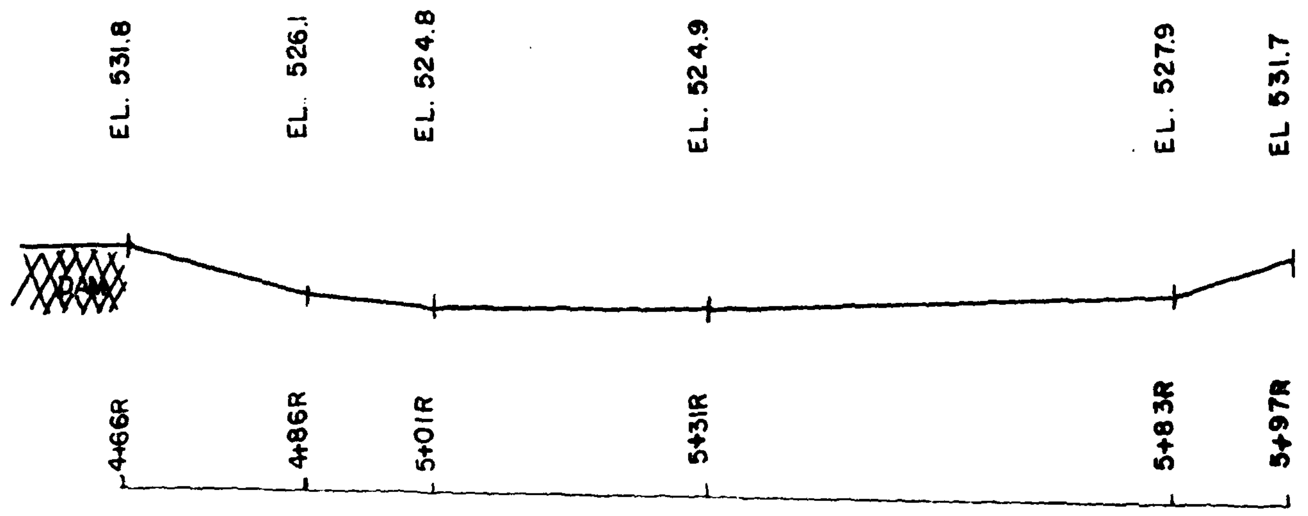
SPRING DAM
DRAWN BY: ADP DATE: 6/29/81 SHEET: 1 OF 5



MAXIMUM SECTION

SCALE 1" = 20'

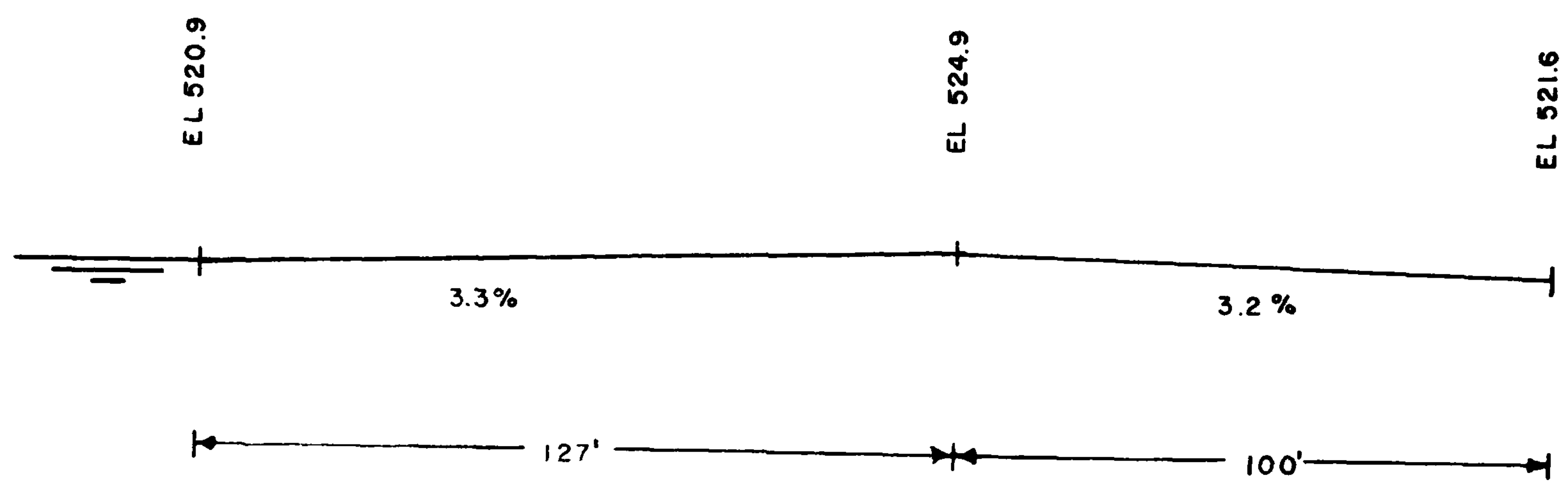
SPRING DAM
DRAWN BY: ADP
DATE: 7/1/81
SHEET: 2 OF 5



EMERGENCY SPILLWAY CONTROL SECTION A-A

SCALE 1"=20'

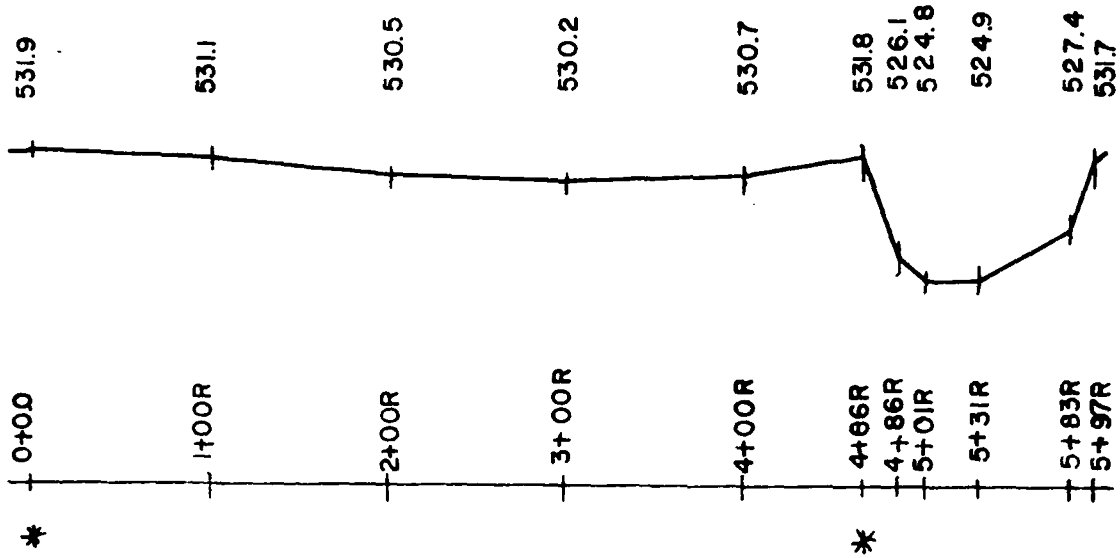
SPRING DAM	
DRAWN BY	ADP
DATE	7/1/81
SHEET	3 OF 5



EMERGENCY SPILLWAY PROFILE

SCALE 1" = 30'

SPRING DAM	
DRAWN BY :	ADP
DATE :	7/1/81
SHEET:	4 OF 5

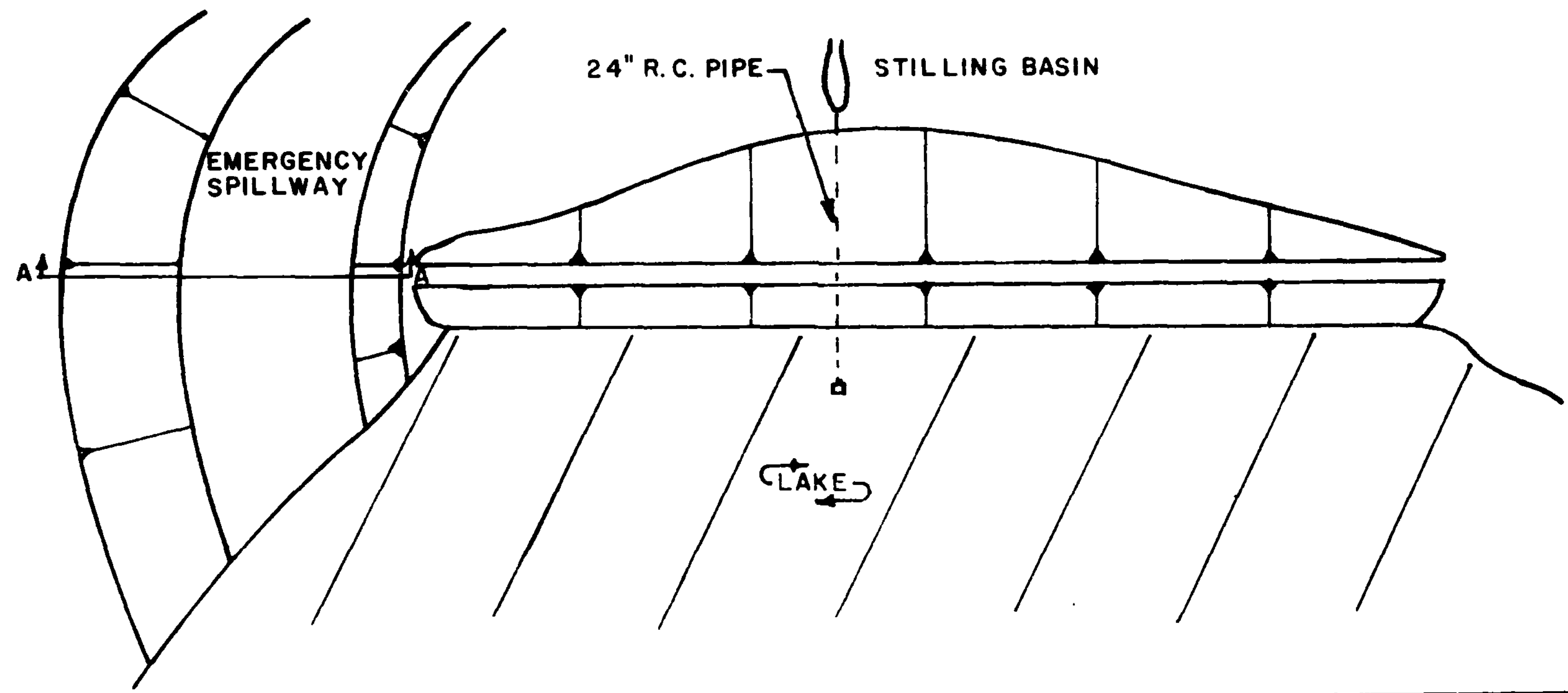


*END OF DAM

CREST ℄ PROFILE

H. SCALE 1" = 100'
V. SCALE 1" = 10'

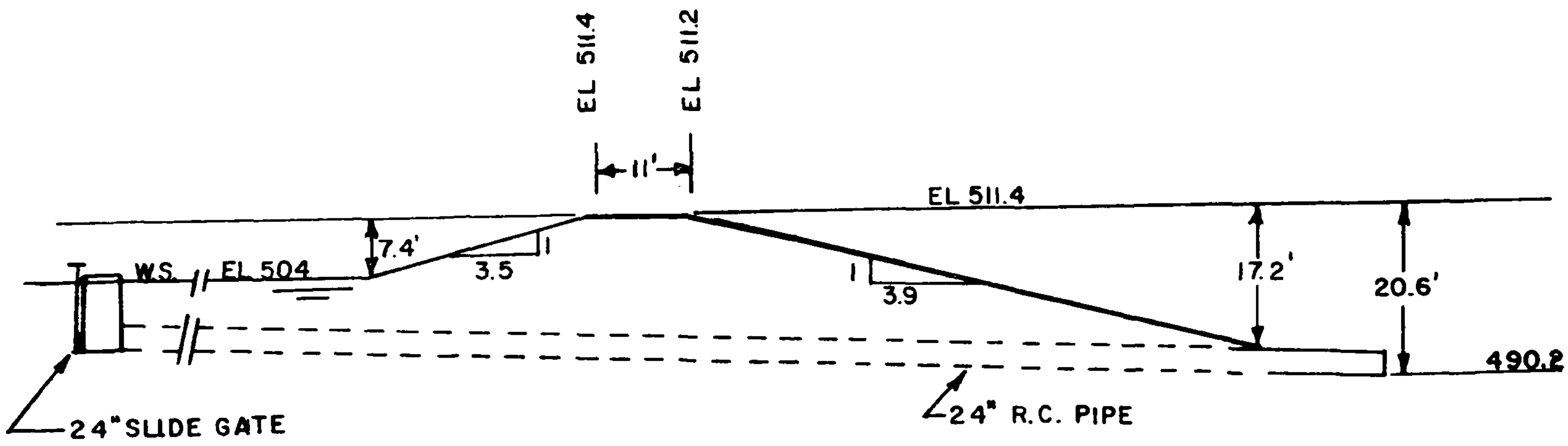
SPRING DAM	
DRAWN BY	ADP
DATE	7/1/81
SHEET	5 OF 5



GENERAL PLAN

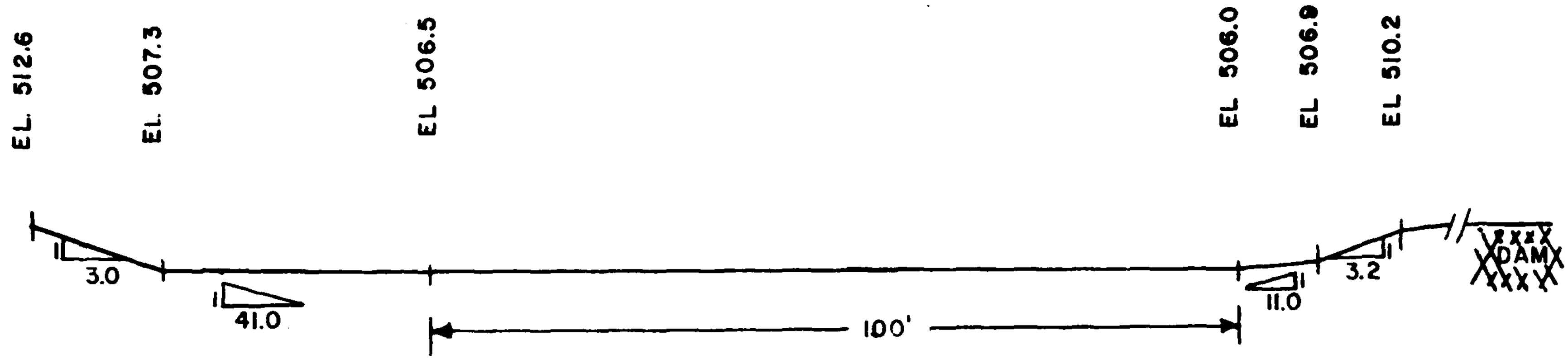
SCALE 1" = 100'

OLD HICKORY DAM
DRAWN BY: ADP
DATE: 7/1/81
SHEET: 1 OF 5



MAXIMUM SECTION
SCALE 1" = 20'

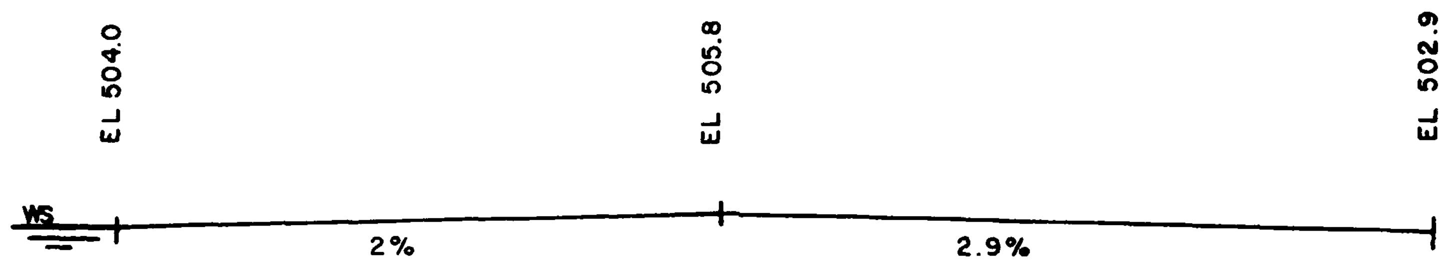
OLD HICKORY DAM	
DRAWN BY	ADP
DATE	7/1/81
SHEET	2 OF 5



EMERGENCY SPILLWAY CONTROL SECTION A-A

SCALE 1" = 20'

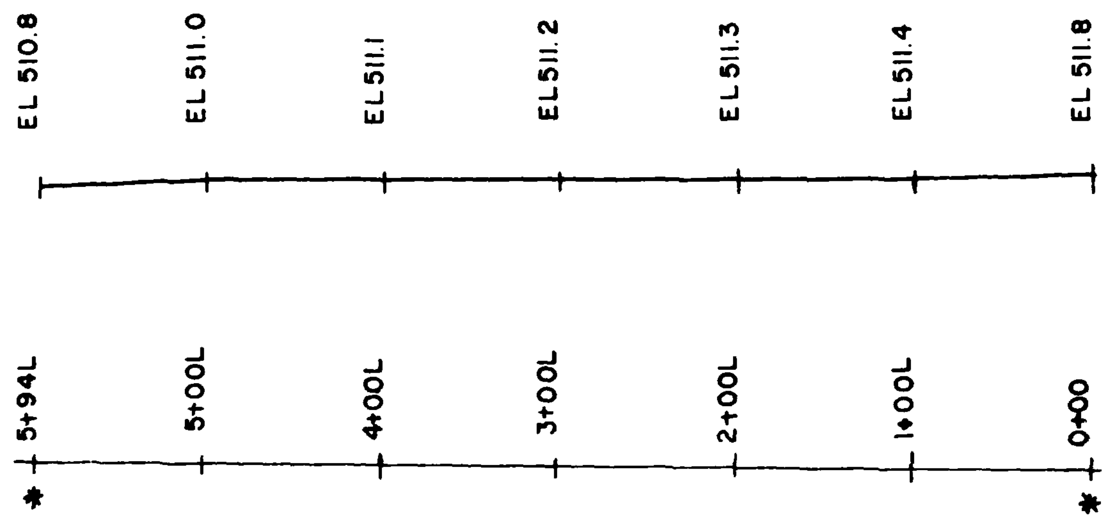
OLD HICKORY DAM	
DRAWN BY	ADP
DATE	7/1/81
SHEET	3 OF 5



EMERGENCY SPILLWAY PROFILE

SCALE 1" = 25'

OLD HICKORY DAM	
DRAWN BY	ADP
DATE	7/1/81
SHEET	4 OF 5



CRESTE PROFILE

H. SCALE 1" = 100'
V. SCALE 1" = 10

*END OF DAM

OLD HICKORY DAM
DRAWN BY: ADP
DATE: 7/1/81
SHEET: 5 OF 5

APPENDIX C

PHOTOGRAPHIC RECORD

Photographic Record

Spring Lake

Photo No. 1 - Overview photo of Spring Lake Dam showing erosion on the downstream slope and in the spillway on the right abutment.

Photo No. 2 - The upstream slope from the left abutment.

Photo No. 3 - The downstream slope from the left abutment.

Photo No. 4 - Another overview of the dam showing more clearly the erosion of the downstream slope.

Photo No. 5 - Inlet to a possible jug hole on the downstream slope.

Photo Nos. 6-8 - Erosion occurring on the downstream slope.

Photo No. 9 - A depression occurring in the fill above the service spillway pipe near the toe.

Photo No. 10 - The service spillway riser.

Photo No. 11 - The service spillway outlet.

Photo No. 12 - The right toe drain outlet with the flap gape forced shut by the thick grass.

Photo No. 13 - The left toe drain outlet with the flap gate stuck and water flowing from a hole behind the gate.

Photo No. 14 - The left toe drain after the gate was forced open. Note sediment in stilling basin.

Photo No. 15 - The entrance channel of the emergency spillway.

Photo No. 16 - The control section of the emergency spillway. Note erosion of the right side slope.

Photo No. 17 - Erosion on the left side slope of the emergency spillway.

Photo No. 18 - The exit channel of the emergency spillway.

Photo Nos. 19 & 20 - Erosion occurring along the left downstream embankment abutment contact.

Photo No. 21 - Standing water near the toe below the left embankment abutment contact.

Old Hickory Lake

Photo No. 22 - The upstream end of Old Hickory Lake from the toe of Spring Lake.

Photo No. 23 - Overview photo of Old Hickory Lake.

Photo No. 24 - The upstream slope of the dam from the right abutment.

Photo No. 25 - The downstream slope of the dam from the right abutment.

Photo No. 26 - A depression possibly due to jugging on the downstream slope.

Photo No. 27 - Erosion on the downstream slope.

Photo No. 28 - A muddy area on the downstream slope.

Photo No. 29 - The entrance channel of the emergency spillway.

Photo No. 30 - The exit channel of the emergency spillway.

Photo No. 31 - The service spillway outlet and right toe drain outlet.

Photo No. 32 - The right toe drain outlet showing an accumulation of dry sediment.

Photo No. 33 - The downstream area from the toe of the dam.

PHOTO NO.1

PHOTO NO.2

PHOTO NO.3

PHOTO NO.4

PHOTO NO.5

PHOTO NO.6

PHOTO NO. 7

PHOTO NO. 8

PHOTO NO. 9

PHOTO NO. 10

PHOTO NO.11

PHOTO NO.12

PHOTO NO.13

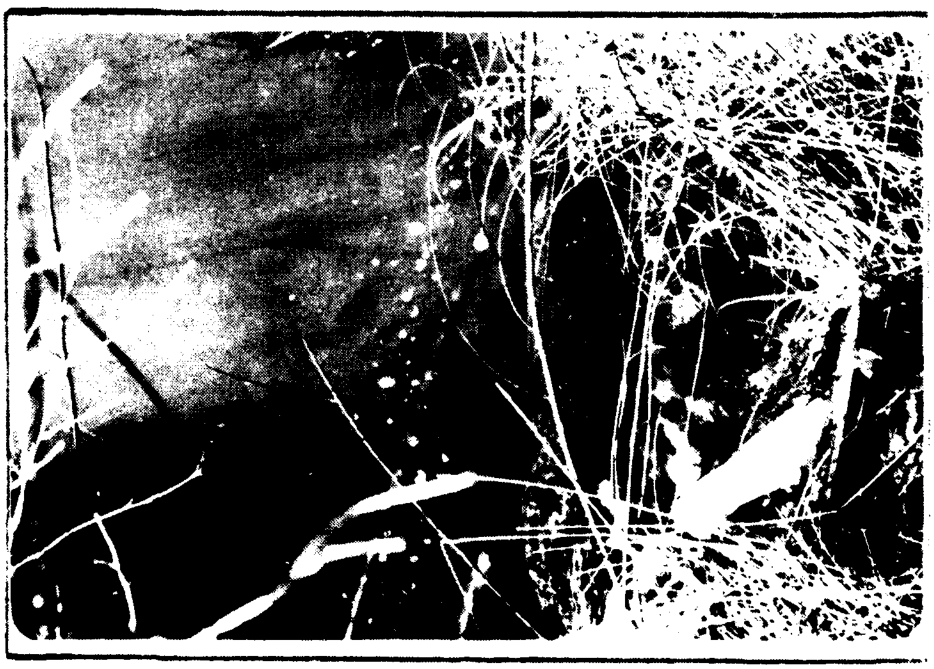


PHOTO NO.14

PHOTO NO.15

PHOTO NO.16

PHOTO NO.17

PHOTO NO.18

PHOTO NO. 19

PHOTO NO. 20

PHOTO NO.21

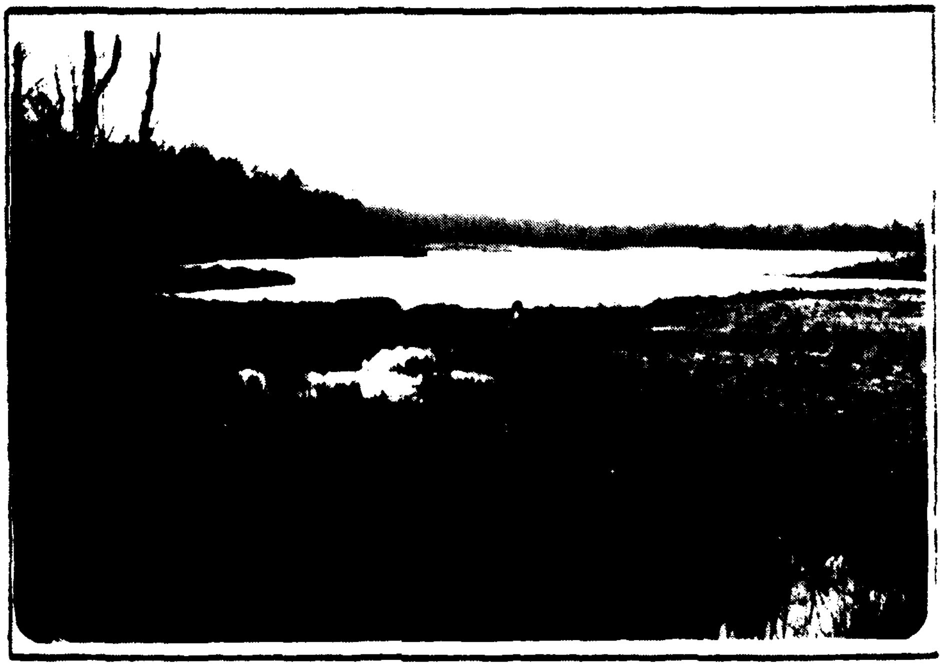


PHOTO NO.22

PHOTO NO.23

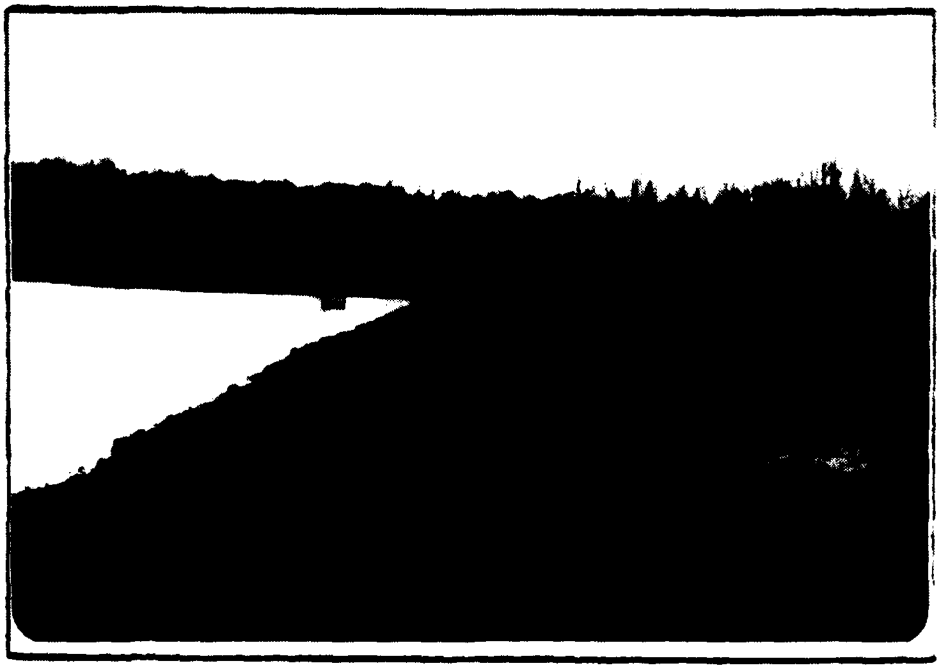


PHOTO NO.24

PHOTO NO.25

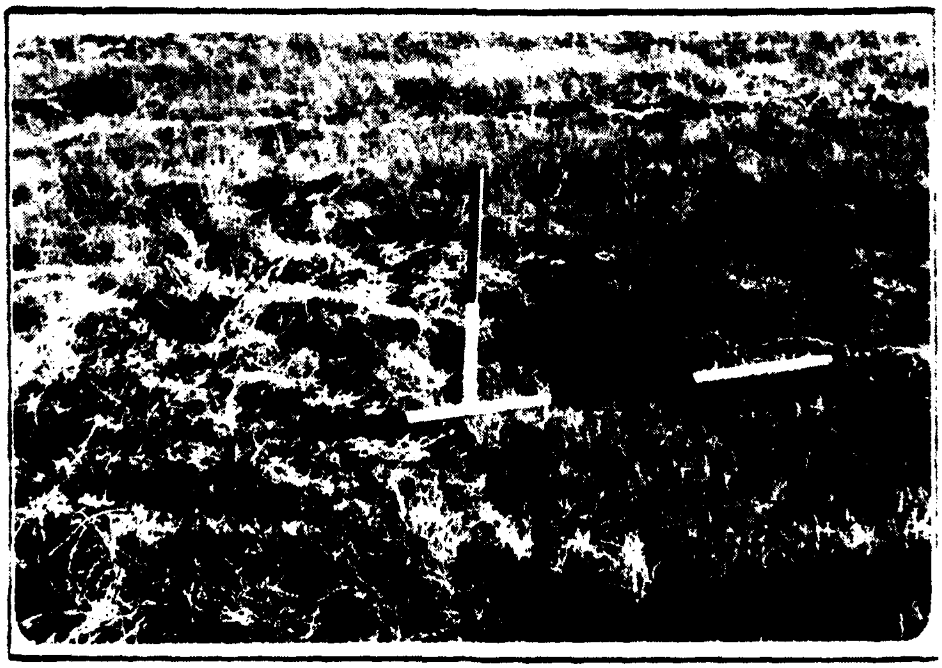


PHOTO NO.26

PHOTO NO.27

PHOTO NO.28

PHOTO NO.29

PHOTO NO.30

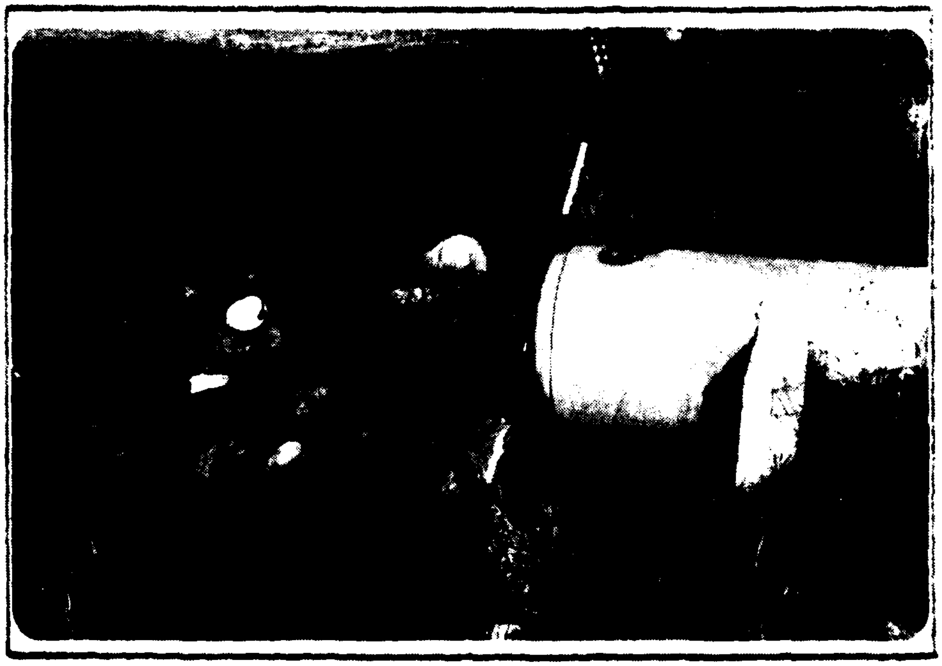


PHOTO NO.31

PHOTO NO.32

PHOTO NO.33

APPENDIX D

CHECKLISTS - VISUAL INSPECTION, ENGINEERING DATA, SOIL TESTS

Check List
Visual Inspection of Earth Dams
Department of Conservation
Division of Water Resources

Name of Dam ·pring

County Hardeman Date of Inspection 3/10/81

ID # - State 35-7026 Federal TN06930

Type of Dam Earth

Hazard Category-Federal High State 1

Weather Clear, light winds Temperature 55°

Pool at Time of Inspection .1' above NPL (distance from crest)

Tailwater at Time of Inspection ______ (distance from stream bed)

Design/As Built Drawings Available: Yes X No ____

Location: TDWR

Copy Obtained: Yes ____ No ____

Reviewed: Yes ____ No ____

Construction History Available: Yes X No ____

Location: TDWR

Copy Obtained: Yes ____ No ____

Reviewed: Yes ____ No ____

Other Records and Reports Available: Yes X No ____

Location: ____

Copy Obtained: Yes ____ No ____

Reviewed: Yes ____ No ____

Prior Incidents or Failures: Yes ____ No X

Inspection Personnel and Affiliation:

Ed O'Neill - TDWR

George Moore - TDWR

Bill Culbert - TDWR

Anthony Privett - TDWR

I. Embankment

A. Crest

Description (1st inspection) Straight

1. Longitudinal Alignment O.K.

2. Longitudinal Surface Cracks None seen

3. Transverse Surface Cracks None seen

4. General Condition of Surface Good with sparse vegetation.

5. Miscellaneous Signs prohibiting traffic.

B. Upstream Slope

1. Undesirable Growth or Debris None

2. Sloughing, Subsidence, or Depressions

Minor erosion at water surface.

3. Slope Protection Vegetation only; berm at water surface.

a. Condition of Riprap None

b. Durability of Individual Stones N/A

c. Adequacy of Slope Protection Against Waves and Runoff O.K.

d. Gradation of Slope Protection - Localized Areas of Fine Material N/A

4. Surface Cracks None seen

C. Downstream Slope

1. Undesirable Growth or Debris None

2. Sloughing, Subsidence, or Depressions; Abnormal Bulges or Non-Uniformity Some erosion excessive in some areas; possible dispersion 50' right of service spillway half way up the slope.

3. Surface Cracks on Face of Slope None seen

4. Surface Cracks or Evidence of Heaving at Embankment Toe None seen

5. Wet or Saturated Areas or Other Evidence of Seepage on Face of Slope; Evidence of "Piping" or "Boils" Damp below level of toe drain; swamp grass and saturated ground about 30 feet left of spillway below railroad tie.

6. Drainage System Outlet flaps stuck; some sediment in flow when left flap first opened.

7. Fill Contact with Outlet Structure Erosion around pipe and one small hole above pipe near toe.

8. Condition of Grass Slope Protection Sparse in some areas.

D. Abutments

1. Erosion of Contact of Embankment with Abutment from Surface Water Runoff, Upstream or Downstream

   Slight erosion; gully at left downstream; spoil area or dozer pile caving in.

2. Springs or Indications of Seepage Along Contact of Embankment with the Abutments None seen

3. Springs or Indications of Seepage in Areas a Short Distance Downstream of Embankment - Abutment Tie-in

   None seen

II. Area Downstream of Embankment, Including Channel

A. Localized Subsidence, Depressions, Sinkholes, Etc. ____

Old Hickory Lake backs up to Spring.

B. Evidence of "Piping", "Boils", or "Seepage" ____

None seen

C. Unusual Presence of Lush Growth, such as Swamp Grass, etc. None

D. Unusual Muddy Water in Downstream Channel None

E. Sloughing or Erosion Minor erosion.

F. Surface Cracks or Evidence of Heaving Beyond Embankment Toe None seen

G. Stability of Channel Sideslopes O.K.

H. Condition of Channel Slope Protection N/A

I. Adequacy of Slope Protection Against Waves, Currents, and Surface Runoff O.K.

J. Miscellaneous

K. Condition of Relief Wells, Drains, and Other Appurtenances None

L. Unusual Increase or Decrease in Discharge from Relief Wells None

III. Instrumentation - None

A. Monumentation/Surveys ______________________________

____

____

B. Observation Wells __________________________________

____

____

C. Weirs ____

____

____

D. Piezometers _______________________________________

____

____

E. Other ____

____

____

IV. Spillways

A. Service Spillway (Service/Emergency Combination Yes __ No X)

1. Intake Structure Condition Good; slightly off plumb.

2. Outlet Structure Condition O.K.; end of pipe cracked.

3. Pipe Condition O.K. at outlet.

4. Evidence of Leakage or Piping None

5. General Remarks

B. Emergency Spillway

1. General Condition O.K.

2. Entrance Channel Erosion

3. Control Section Erosion on side slopes.

3. Exit Channel ___Erosion___

4. Vegetative/Woody Cover ___Sparse cover.___

5. Other Observations ______

V. Emergency Drawdown Facilities (if part of service spillway so state) Valve on service spillway riser.

Are Facilities Operable: Yes _____ No _____ Unknown

Were Facilities Operated During Inspection: Yes _____ No X

Date Facilities Were Last Used Unknown

VI. Reservoir

A. Slopes O.K.

B. Sedimentation Minor

C. Turbidity High

VII. Drainage Area

Description (for hydrologic analysis)

Primarily low density residence; woods.

A. Changes in Land Use

VIII. Downstream Area (Stream)

A. Condition (obstructions, debris, etc.) ______

Old Hickory Lake

B. Slopes ______

C. Approximate No. Homes, Population, and Distance D/S

D. Other Hazards ______

IX. Miscellaneous

Incidents/Failures None

Observed Geology of Area Sand

X. Conclusions

Deficient due to erosion.

XI. Recommendations

Operate gate.

Improve grass.

Fill erosion.

Monitor hole above pipe.

George S. Moore
Regional Engineer

Chief Engineer

Check List
Visual Inspection of Earth Dams
Department of Conservation
Division of Water Resources

Name of Dam Old Hickory

County Hardeman Date of Inspection 3/10/81

ID # - State 35-7030 Federal TN 06926

Type of Dam Earth

Hazard Category-Federal ______ State ______

Weather Clear, light winds Temperature 55°

Pool at Time of Inspection About NPL (distance from crest)

Tailwater at Time of Inspection 0 (distance from stream bed)

Design/As Built Drawings Available: Yes X No ___

Location: TDWR

Copy Obtained: Yes X No ___

Reviewed: Yes X No ___

Construction History Available: Yes X No ___

Location: TDWR

Copy Obtained: Yes X No ___

Reviewed: Yes X No ___

Other Records and Reports Available: Yes X No ___

Location: ______

Copy Obtained: Yes ___ No ___

Reviewed: Yes ___ No ___

Prior Incidents or Failures: Yes ___ No X

Inspection Personnel and Affiliation:

Ed O'Neill - TDWR

George Moore - TDWR

Bill Culbert - TDWR

Anthony Privett - TDWR

I. Embankment

A. Crest

Description (1st inspection) Straight

1. Longitudinal Alignment O.K.

2. Longitudinal Surface Cracks None seen

3. Transverse Surface Cracks None seen

4. General Condition of Surface Good, almost no cover.

5. Miscellaneous Several small depressions near D/S edge about 2' square and about 6" deep.

B. Upstream Slope

1. Undesirable Growth or Debris None

2. Sloughing, Subsidence, or Depressions Minor erosion.

3. Slope Protection Very sparse vegetation.

   a. Condition of Riprap None

   b. Durability of Individual Stones N/A

   c. Adequacy of Slope Protection Against Waves and Runoff Good; some erosion near left end.

   d. Gradation of Slope Protection - Localized Areas of Fine Material N/A

4. Surface Cracks None seen; one very small jug hole outlet about 2' below inlet.

C. Downstream Slope

1. Undesirable Growth or Debris None

2. Sloughing, Subsidence, or Depressions; Abnormal Bulges or Non-Uniformity Excessive erosion; 2' to 3' gullies and jugging; very soft mud in spots up to 3' deep 1/3 - 2/3 D/S.

3. Surface Cracks on Face of Slope None seen.

4. Surface Cracks or Evidence of Heaving at Embankment Toe None seen.

5. Wet or Saturated Areas or Other Evidence of Seepage on Face of Slope; Evidence of "Piping" or "Boils" Lower part of slope extremely muddy in comparison with other areas.

6. Drainage System Dry sediment in right pipe; no flow right, slight flow in left.

7. Fill Contact with Outlet Structure Minor erosion.

8. Condition of Grass Slope Protection Sparse

Vent pipe on each end; check plans.

D. Abutments

1. Erosion of Contact of Embankment with Abutment from Surface Water Runoff, Upstream or Downstream ________

   Minor erosion.

2. Springs or Indications of Seepage Along Contact of Embankment with the Abutments Wet along lower part of embankment abutment on each side.

3. Springs or Indications of Seepage in Areas a Short Distance Downstream of Embankment - Abutment Tie-in

II. Area Downstream of Embankment, Including Channel

A. Localized Subsidence, Depressions, Sinkholes, Etc. _____

None seen.

B. Evidence of "Piping", "Boils", or "Seepage" _____

Entire area below toe wet but no evidence of flow.

C. Unusual Presence of Lush Growth, such as Swamp Grass, etc. In wet area; see B.

D. Unusual Muddy Water in Downstream Channel None seen

E. Sloughing or Erosion None seen

F. Surface Cracks or Evidence of Heaving Beyond Embankment Toe None seen

G. Stability of Channel Sideslopes Good

H. Condition of Channel Slope Protection None

I. Adequacy of Slope Protection Against Waves, Currents, and Surface Runoff O.K.

J. Miscellaneous

K. Condition of Relief Wells, Drains, and Other Appurtenances None

L. Unusual Increase or Decrease in Discharge from Relief Wells None

III. Instrumentation - None

A. Monumentation/Surveys ______

B. Observation Wells ______

C. Weirs ______

D. Piezometers ______

E. Other ______

IV. Spillways

A. Service Spillway (Service/Emergency Combination Yes __ No X)

1. Intake Structure Condition O.K.

2. Outlet Structure Condition O.K.

3. Pipe Condition Good at outlet.

4. Evidence of Leakage or Piping None

5. General Remarks

B. Emergency Spillway

1. General Condition Good

2. Entrance Channel Minor erosion.

3. Control Section Eroding side slopes.

3. Exit Channel Some erosion.

4. Vegetative/Woody Cover Almost non-existent.

5. Other Observations

V. Emergency Drawdown Facilities (if part of service spillway so state) On service spillway riser.

Are Facilities Operable: Yes _____ No _____ Unknown

Were Facilities Operated During Inspection: Yes _____ No X

Date Facilities Were Last Used _____

VI. Reservoir

A. Slopes O.K.

B. Sedimentation Minor

C. Turbidity Brownish green; about 2' visibility.

VII. Drainage Area

Description (for hydrologic analysis) Part controlled by Spring; remainder medium density residential wooded lots.

A. Changes in Land Use

VIII. Downstream Area (Stream)

A. Condition (obstructions, debris, etc.) Trees

B. Slopes Almost flat.

C. Approximate No. Homes, Population, and Distance D/S

Numerous lots being developed.

D. Other Hazards Hwy 57; mainline Southern Railroad.

IX. Miscellaneous

Incidents/Failures None

Observed Geology of Area Sand

X. Conclusions

Significantly deficient due to excessive erosion and possible dispersive soils.

XI. Recommendations

Control erosion.

Monitor formation of holes.

Engineer should check for dispersive soils and recommend corrective action.

George S. Moore
Regional Engineer

Chief Engineer

OHIO RIVER DIVISION, NASHVILLE DISTRICT
SOIL TEST DATA SUMMARY

PROJECT OLD HICKORY HOLE 1 ELEV. TOP ______ SHEET 1 OF 1 SHEETS

SAMPLE NO.	DEPTH OF SAMPLE	LABORATORY CLASSIFICATION	NAT. WATER CONT.	ATTERBERG LIMITS		MECHANICAL ANAL.		
				LL	PL	Gravel %	Sand %	Fines %
1	0.0 - 1.0	GRAY SILTY, SANDY, CLAY. STIFF, SLIGHTLY DAMP, SLIGHTLY MICACEOUS, SLIGHTLY CARBONACEOUS, SLIGHTLY ORGANIC. (CL)	16.0	28.0	14.9	0.0	26.5	73.5

ORN 388
SEPT 67

ORNED-D

OHIO RIVER DIVISION, NASHVILLE DISTRICT
SOIL TEST DATA SUMMARY

PROJECT SPRING LAKE DAM HOLE 1 ELEV. TOP ______ SHEET 1 OF 1 SHEET

SAMPLE NO.	DEPTH OF SAMPLE	LABORATORY CLASSIFICATION	NAT. WATER CONT.	ATTERBERG LIMITS		MECHANICAL ANAL		
				LL	PL	Gravel %	Sand %	F
1	0.0-1.0	RED-BROWN w/OCCASIONAL GRAY, CLAYEY SAND, SLIGHTLY DAMP, SLIGHTLY MICACEOUS, SLIGHTLY ORGANIC. (SC)	13.0	29.4	14.6	0.0	[illegible]	[illegible]

ORN 344
SEPT 67

ORN ED D

APPENDIX E

HYDRAULIC AND HYDROLOGIC DATA

HYDRAULIC AND HYDROLOGIC CALCULATIONS

Spring Lake Dam and Old Hickory Dam are located in Hardeman County, Tennessee. Twenty one percent of the drainage area of Spring Lake is controlled by Chancellor and Son Dam and Spring Lake Dam controls 53% of the drainage area of Old Hickory Lake. The watershed land use is residential subdivision with 1/3 acre wooded lots. The predominant soils are Ruston (HSG B), Lexington (HSG B), and Providence (HSG C). The runoff curve number using antecedent moisture condition II was calculated to be 76.

Both dams are classified as small size, high hazard potential dams. As such, they are required to pass the 1/2 to the full probable maximum flood (PMF) without overtopping. The PMF is derived from the probable maximum precipitation (PMP). Using the U. S. Weather Service TP 40, the 6-hour PMP was estimated to be 29.7 inches yielding 26.2 inches of runoff (RCN 76, AMC II).

The PMF was routed through the system of dams assuming the Chancellor and Son Dam can handle the flow safely. The ½ PMF was routed assuming a breach of Chancellor and Son Dam at the peak of its outflow. Necessary information on Chancellor and Son Dam have been included in this report.

The total inflow into Spring Lake during the PMF is 388 acre-feet with a peak of 3675 cfs. Spring Lake has 140 acre-feet of storage above normal pool and the dam has a maximum spillway capacity of 3620 cfs. The impoundment will pass the PMF with 1.1 feet of freeboard. The ½ PMF with the breach of Chancellor and Son produces a peak inflow rate of 6400 cfs. Routing indicates that Spring Lake Dam will be overtopped for about 0.2 hours with a maximum depth of about 1 foot. Spring Lake Dam is assumed to breach for the ½ PMP routing of Old Hickory Dam.

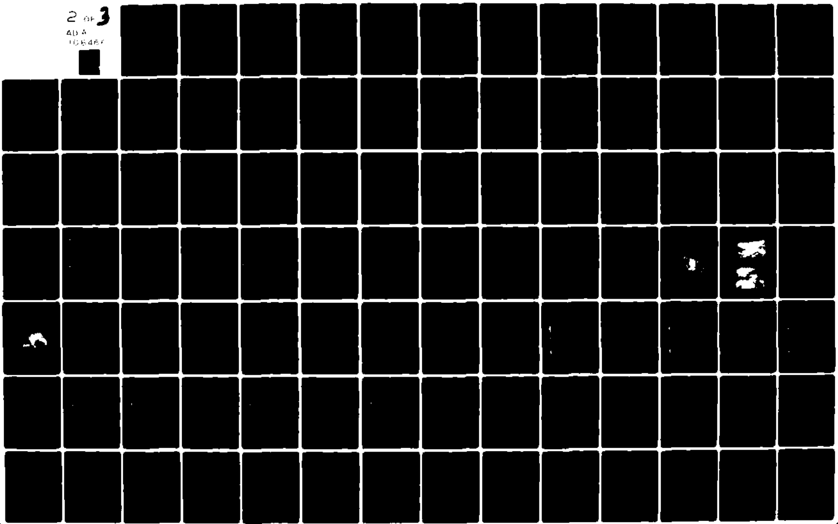
The total inflow into Old Hickory Lake during the PMF is 753 acre-feet with a peak of 4710 cfs. Old Hickory Lake has 220 acre-feet of storage above normal pool and the dam has a maximum spillway capacity of 4730 cfs. The impoundment will pass the PMF with 0.8 feet of freeboard. The ½ PMF with the breach of Spring Lake Dam produces a peak inflow rate of 7595 cfs. Routing indicates that Old Hickory Dam will pass the ½ PMF with 0.4 feet of freeboard.

The entire system of dams is assumed to fail during the AMC III PMF. The Chancellor Dam is overtopped slightly by the AMC II PMF; therefore, it is assumed that the AMC III PMF will be overtopped by a significant amount and the dam

AD-A108 466 TENNESSEE STATE DEPT OF CONSERVATION NASHVILLE DIV O--ETC F/G 13/13
NATIONAL PROGRAM OF INSPECTION OF NON-FEDERAL DAMS, TENNESSEE. --ETC(U)
SEP 81 G E MOORE DACW62-81-C-0056

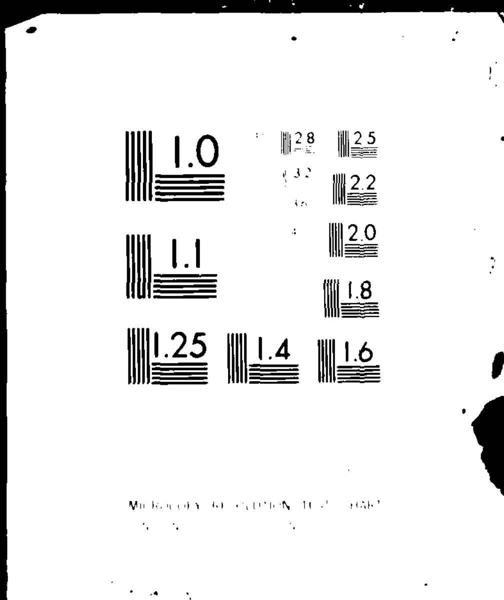
UNCLASSIFIED NL

2 OF 3
AD A
108466



2 OF 3

AD A
108466



will fail. Since the Spring Lake Dam is overtopped by a failure of Chancellor during the ½ PMF, Spring will be overtopped and assumed to fail during the AMC III PMF. The 0.4 feet of freeboard which remained on Old Hickory at the peak of the ½ PMF routing is not considered sufficient to handle the increase inflows and enhanced peaks associated with the AMC III PMF.

The 6-hour 100 year flood containing 5.5 inches of precipitation was routed through the reservoir using a RCN of 88 (AMC III). This produced 64.7 acre-feet of runoff with a peak rate of 500 cfs into Spring Lake. Routing indicated flow in the emergency spillway for 1.6 hours with a maximum depth of about 0.1 foot. The uncontrolled drainage area of Old Hickory contributed an additional 59 acre-feet of inflow. Routing of the storm through Old Hickory Dam produced no flow in the emergency spillway.

The inflow hydrographs were calculated by methods contained in Section 4, Chapter 21, of the SCS National Engineering Handbook. Hydraulic calculations were performed as per King & Brater's "Handbook of Hydraulics", Sixth Edition. The routing equation used was:

OLD HICKORY LAKE DAM

SUMMARY OF ROUTINGS

EVENT	ANTECEDENT MOISTURE CONDITION	
	II	III
PMF*	Passed with 0.8 ft. of freeboard	Not routed Assumed overtopped
½ PMF**	Passed with 0.4 ft. of freeboard	Not routed
100 - YEAR	Passed; no flow in emergency spillway	Passed; no flow in emergency spillway

*Passed by Chancellor and Spring
**Includes breach of Chancellor and Spring

SPRING LAKE DAM

SUMMARY OF ROUTINGS

EVENT	ANTECEDENT MOISTURE CONDITION	
	II	III
PMF*	Passed with 1.1 feet of freeboard	Overtopped Assumed failed
½ PMF**	Overtops; maximum depth 1 foot; duration 0.2 hours	Not routed
100 - YEAR	Passes; no flow in emergency spillway	Passes; flow in emergency spillway; max. depth 0.1 ft; duration 1.6 hours

*Passed by Chancellor

**Includes breach of Chancellor

SPRING LAKE | INFLOW HYDROGRAPH 23MAR 81 [illegible]

DA UNCONTROLLED = 147 Ac = .23 mi²
CONTROLLED = 40 Ac = .06 mi² (CHANCELLOR AND [illegible])
TOTAL = = 187 Ac = .29 mi²

NPA = 11 Ac

PREDOMINANT SOIL GROUP: RUSTON (B), LEXINGTON (B), PROVIDENCE (C)

COVER: MEDIUM DENSITY RESIDENTIAL WITH WOODED LOTS, 7.5% WATER

CN = 75 AMC II, 88 AMC III

MAXIMUM RELIEF = 120 ft

FETCH = 1000 ft

REACH (ℓ) = 2000 ft

SLOPE (Y) = 10.9 %

AMC II

$L = .195$ hr

$T_c = .324$ hr

$T_p = .227$ hr

PMP = 29.7 IN

Q = 26.0 IN

HYDROGRAPH FAMILY # 1

$T_o = 5.7$ hr

T_o/T_p = 25.1

REV T_o/T_p = 25

REV T_p = .228 hr

q_p = 4[illegible]1.0 cfs/IN

Q_{qp} = 12694 cfs

q_{max} = 2945 @ 2.23 hr

V[illegible]

$V_I = 4.15 \frac{1}{12} \times 187 = 64.7$ Ac ft

V_{SW} [illegible]

[illegible] .12

AMC III

$L = .127$

$T_c = .212$

$T_p = .149$

P_{100} = 5.5 IN

Q = 4.15 IN

HYDROGRAPH FAMILY # 2

$T_o = 5.3$ hr

T_o/T_p = 35.6 hr

REV T_o/T_p = 36

REV T_p = .147 hr

q_p = 755 cfs/in

Q_{qp} = 3134 cfs

q_{max} = 492 cfs @ 1.58 hr

SPRING LAKE · P_{100} INFLOW HYDROGRAPH 23 MAR 81 AOP

Q_{qp} = 3134 cfs T_p = .147 hr

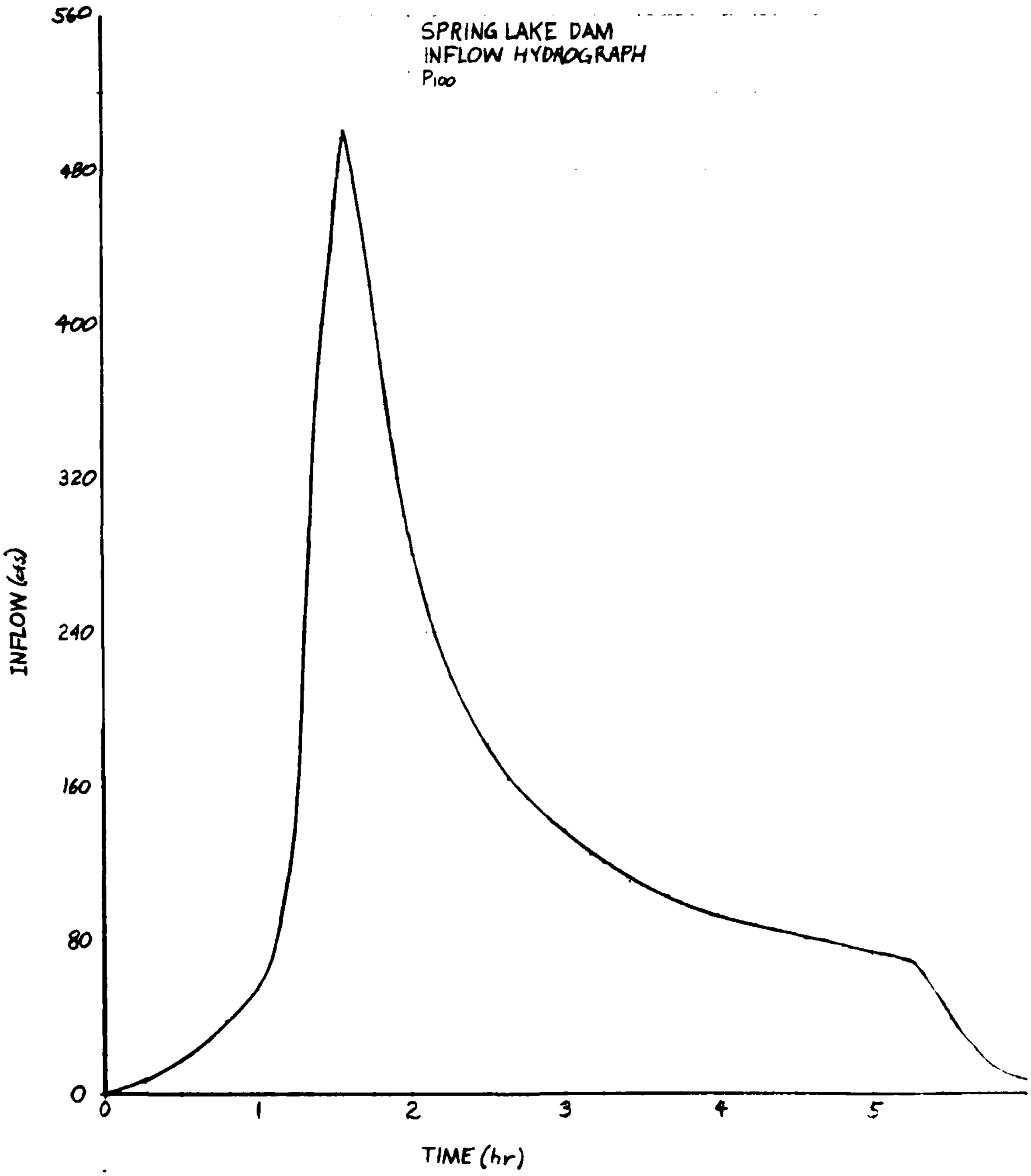
HYDRO GRAPH FAMILY #2 T_o/T_p = 36 hr.

No.	t/Tp	t(hr)	q/qp	q (cfs)		
1	0	0	0	0		
2	1.79	.26	.002	6		
3	3.58	.53	.006	19		
4	5.37	.79	.012	38		
5	7.16	1.05	.019	60		
6	8.95	1.32	.057	179	+1	
7	10.74	1.58	.157	492	+8	
8	12.53	1.84	.104	326	+32	
9	14.32	2.11	.068	213	+91	
10	16.11	2.37	.047	147	42	
11	17.90	2.63	.040	125	39	
12	[illegible]	2.89	.034	107	35	
13	21.48	3.16	.030	94	32	104
14	23.27	3.42	.026	82	28	110
15	25.06	3.69	.025	78	25	[illegible]
16	[illegible]	3.95	.023	72	23	95
17	28.64	4.21	.021	66	22	[illegible]
18	30.93	4.47	.020	[illegible]	20	[illegible]
19	32.22	4.74	.019	[illegible]	18	[illegible]
20	34.01	4.99	.018	56	17	[illegible]
21	35.80	5.26	.017	53	16	69
22	37.59	5.53	.007	22	14	[illegible]
23	39.38	5.79	.001	[illegible]	11	[illegible]
24	41.17	6.05	0	0	9	[illegible]
25					7	7

SPRING LAKE DAM P_{100} ROUTING [illegible] 2 JUNE 81

TIME (hr)	INFLOW (cfs)	$^{2S}/_{\Delta t} - O$	$^{2S}/_{\Delta t} + O$	OUTFLOW (cfs)
0	0	0	0	0
.2	5	5	5	0
.4	13	23	23	0
.6	23	57	59	1
.8	37	113	117	2
1.0	55	199	205	3
1.2	114	358	368	5
1.4	310	762	782	10
1.6	500	1538	1572	17
1.8	382	2384	2420	18
2.0	286	3014	3052	19
2.2	229	3491	3529	19
2.4	186	3868	3906	19
2.6	168	4184	4222	19
2.8	150	4464	4502	19
3.0	136	4712	4750	19
3.2	124	4934	4972	19
3.4	113	5133	5171	19
3.6	104	5312	5350	19
3.8	98	5476	5514	19
4.0	92	5628	5666	19
4.2	88	5770	5808	19
4.4	84	5904	5942	19
4.6	80	6030	6068	19
4.8	77	6149	6187	19
5.0	73	6243	6299	28
5.2	70	6312	6386	37
5.4	53	6351	6435	42
5.6	28	6348	6432	42
5.8	13	6315	6389	37
6.0	8	6274	6336	31
6.2	6	6236	6288	26
	5	6205	6247	21
			6215	19

FLOW [illegible] 1.6hr
MAX DEPTH ~ 0.1ft

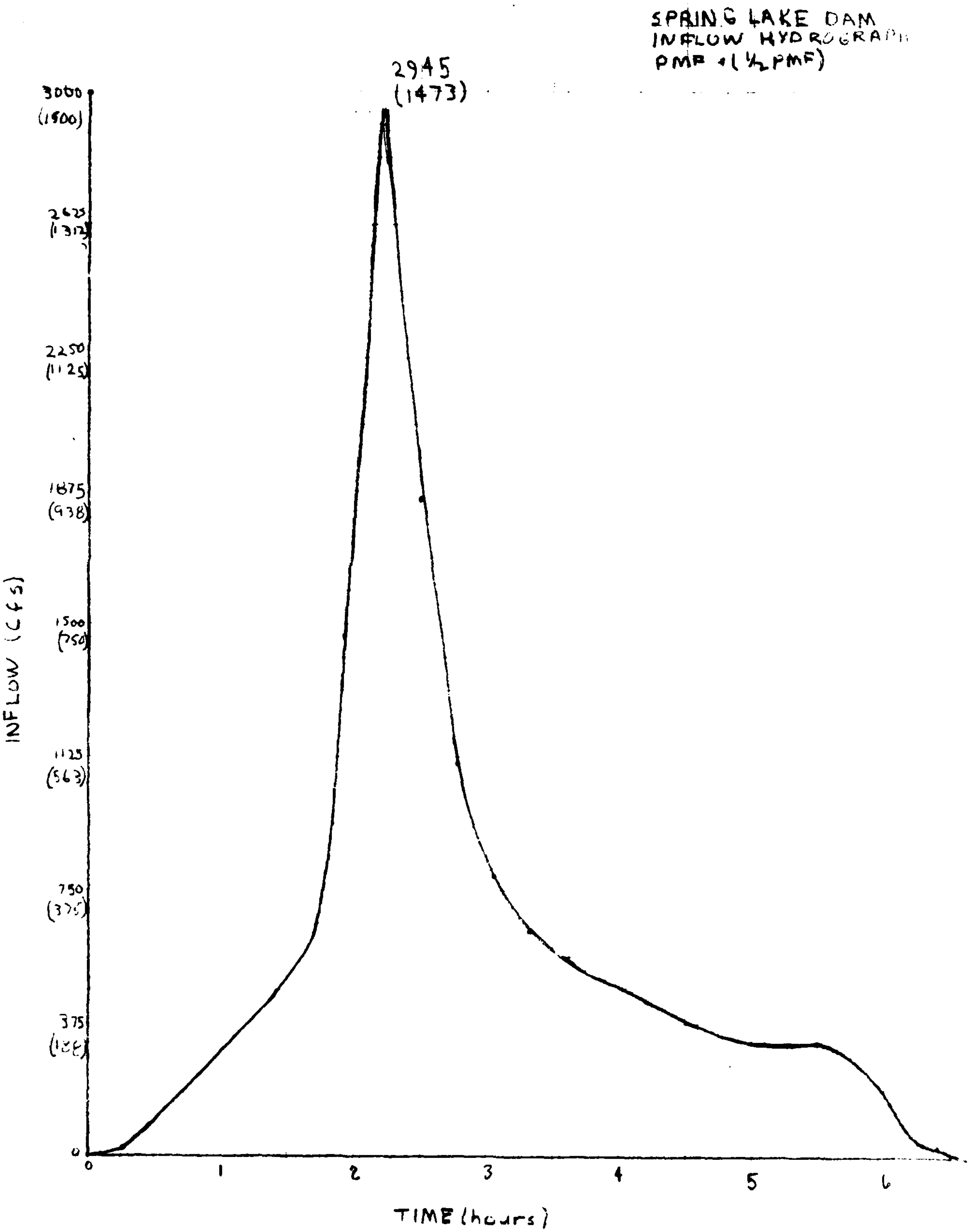

SPRING LAKE DAM
INFLOW HYDROGRAPH
P100
INFLOW (cfs)
560
480
400
320
240
160
80
0
TIME (hr)
0
1
2
3
4
5

SPRING LAKE PMF INFLOW HYDROGRAPH 23 MAR 81 ADP

Q_{qp} = 12694 cfs T_p = .228 hr

HYDROGRAPH FAMILY #1 T_0/T_p - 25

No.	t/T_p	t(hr)	q/q_p	½ PMF q(cfs)	PMF q(cfs)
1	0	0	0	0	0
2	1.22	.28	.002	12	25
3	2.44	.56	.009	57	114
4	3.66	.83	.018	114	228
5	4.88	1.11	.027	171	342
6	6.10	1.39	.036	228	457
7	7.32	1.66	.046	292	584
8	8.54	1.94	.116	736	1472
9	9.76	2.23	[illegible]	1472	2945
10	10.98	2.50	[illegible]	927	1853
11	12.20	2.78	.088	559	1117
12	13.42	3.01	.062	[illegible]	787
13	14.64	3.34	.051	324	647
14	15.86	3.62	.045	286	571
15	17.08	3.89	[illegible]	248	495
16	18.30	4.17	[illegible]	222	[illegible]
17	19.52	4.45	.031	[illegible]	394
18	20.74	4.72	.027	171	[illegible]
19	[illegible]	5.01	.025	59	317
20	23.18	5.29	.025	159	317
21	24.4	5.56	.025	159	317
22	25.62	5.84	.020	127	254
23	26.84	6.12	.005	32	64
24	28.06	6.40	.002	13	25
25	29.28	6.68	0	0	0



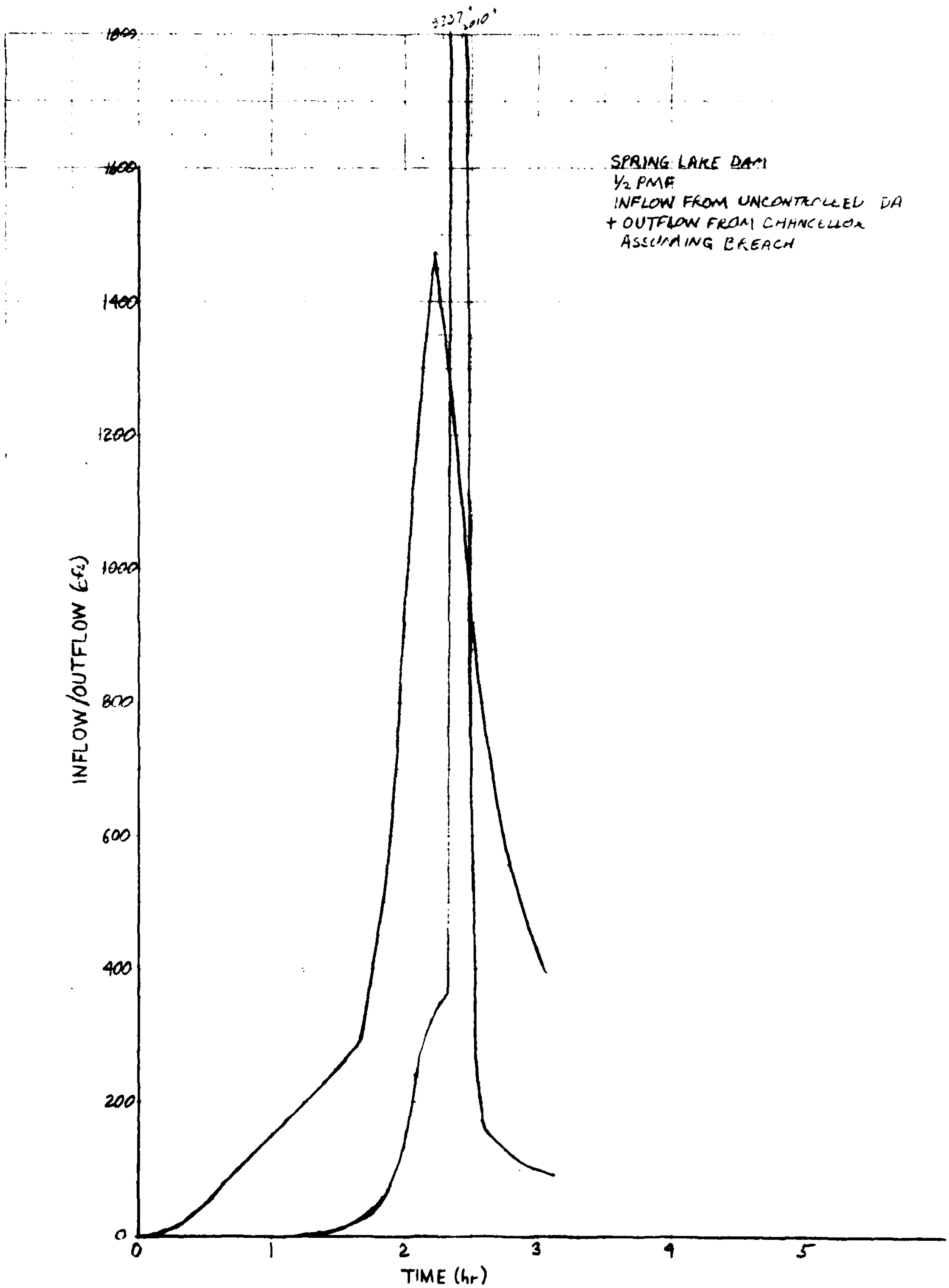
SPRING LAKE DAM
INFLOW HYDROGRAPH
PMF + (½ PMF)
2945
(1473)
3000
(1500)
2625
(1312)
2250
(1125)
1875
(938)
1500
(750)
1125
(563)
750
(375)
375
(188)
0
INFLOW (CFS)
0
1
2
3
4
5
6
TIME (hours)

SPRING LAKE DAM | PMF ROUTING 25 MAR 81 gem.

TIME (hr)	INFLOW (cfs)	2S/Δt − O	2S/Δt + O	OUTFLOW (cfs)	
0	0	0	0	0	
.2	15	15	15	0	
.4	30	58	60	1	
.6	105	189	193	2	
.8	220	500	514	7	
1.0	305	999	1025	13	
1.2	400	1668	1704	18	
1.4	500	2530	2568	19	
1.6	650	3642	3680	19	
1.8	1000	5254	5259	19	
2.0	2325	7819	8579	380	
2.2	3675	10659	13819	1580	
2.4	3055	12349	17389	2520	
2.6	1870	12274	17274	2500	PEAK PASSES
2.8	1350	11434	15494	2030	
3.0	1055		13839	1590	

SPRING LAKE ½PMF ROUTING WITH BREACH of CHANCELLOR + SON DAM MAY 26 91 [illegible]

TIME (hr)	INFLOW (cfs)	$2S/\Delta t - O$	$2S/\Delta t + O$	OUTFLOW (cfs)	
0	0	0	0	0	
.1	2	0	2	0	
.3	17	21	21	0	
.5	49	83	97	7	
.7	90	216	222	3	
.9	130	424	436	6	
1.1	170	704	724	10	
1.3	210	1058	1084	13	
1.5	260	1494	1528	17	
1.7	360	2078	2114	18	
1.9	710	3112	3148	18	
2.1	1470	5256	5292	18	
2.3	10700	12146	17426	2640	
2.5	1800	13606	24646	5520	OVERTOPS [illegible]
2.7	760	11760	16166	2200	
2.9	560		13036	1390	


3337*
2010*
SPRING LAKE DAM
1/2 PMF
INFLOW FROM UNCONTROLLED DA
+ OUTFLOW FROM CHANCELLOR
ASSUMING BREACH
1800
1600
1400
1200
1000
800
600
400
200
0
INFLOW/OUTFLOW (cfs)
0
1
2
3
4
5
TIME (hr)

46 1240

SPRING LAKE DAM SPILLWAY RATING 4 MAR 81 [illegible]

ELEVATION	SERVICE SPILLWAY				EMERGENCY SPILLWAY		TOTAL OUTFLOW
	WEIR FLOW		PIPE FLOW				
(Ft MSL)	h(ft)	Q(cfs)	h(Ft)	Q(cfs)	Hm(Ft)	Q(cfs)	Qt (cfs)
521	0	0					0
521.5	0.5	8.5	12.0	16.4			8.5
522	1.0	24.2	12.5	16.7			16.7
524	3.0	125.5	14.5	18.0			18.0
525			15.5	18.6	0	0	18.6
526			16.5	19.2	1	268.[illegible]	288
527			17.5	19.8	2	776.5	79[illegible]
529			19.5	20.9	4	229[illegible]	[illegible]
530.2			20.7	21.5	5.2	349[illegible]	[illegible]

SERVICE SPILLWAY

WEIR FLOW $Q = CLH^{3/2}$ $L = 8$ Ft $C = [illegible]$ KINGS HANDBOOK [illegible]

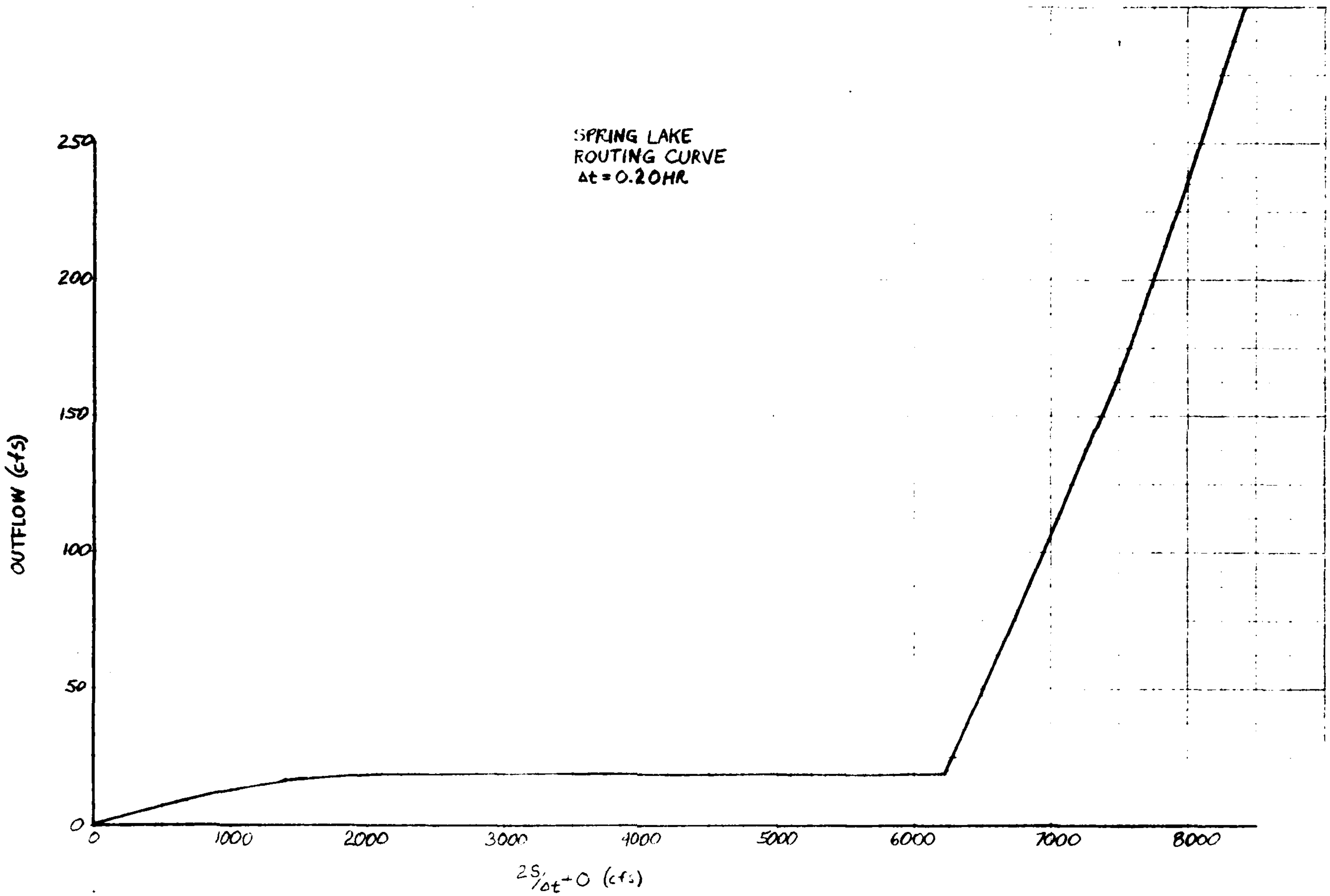
PIPE FLOW $Q = Ca\sqrt{2gh}$ $C = .48$ $a = \pi(.625)^2$ Ft^2 KINGS HANDBOOK [illegible]

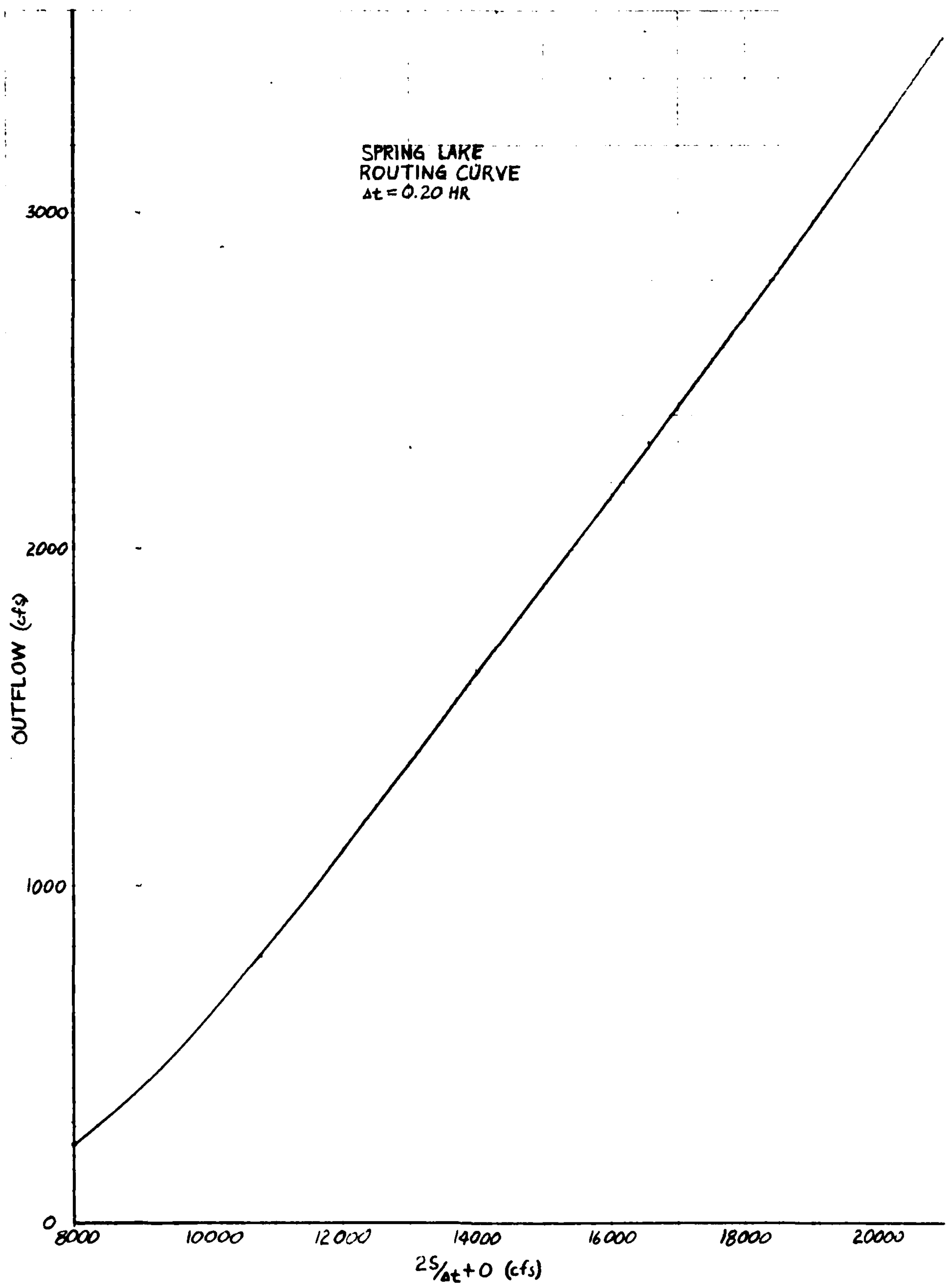
EMERGENCY SPILLWAY $Q = C_2 b H_m^{3/2}$ $b = 85$ Ft $Z = 3$ KINGS HANDBOOK [illegible]

FOR C_2 VALUES SEE TABLE 8-7

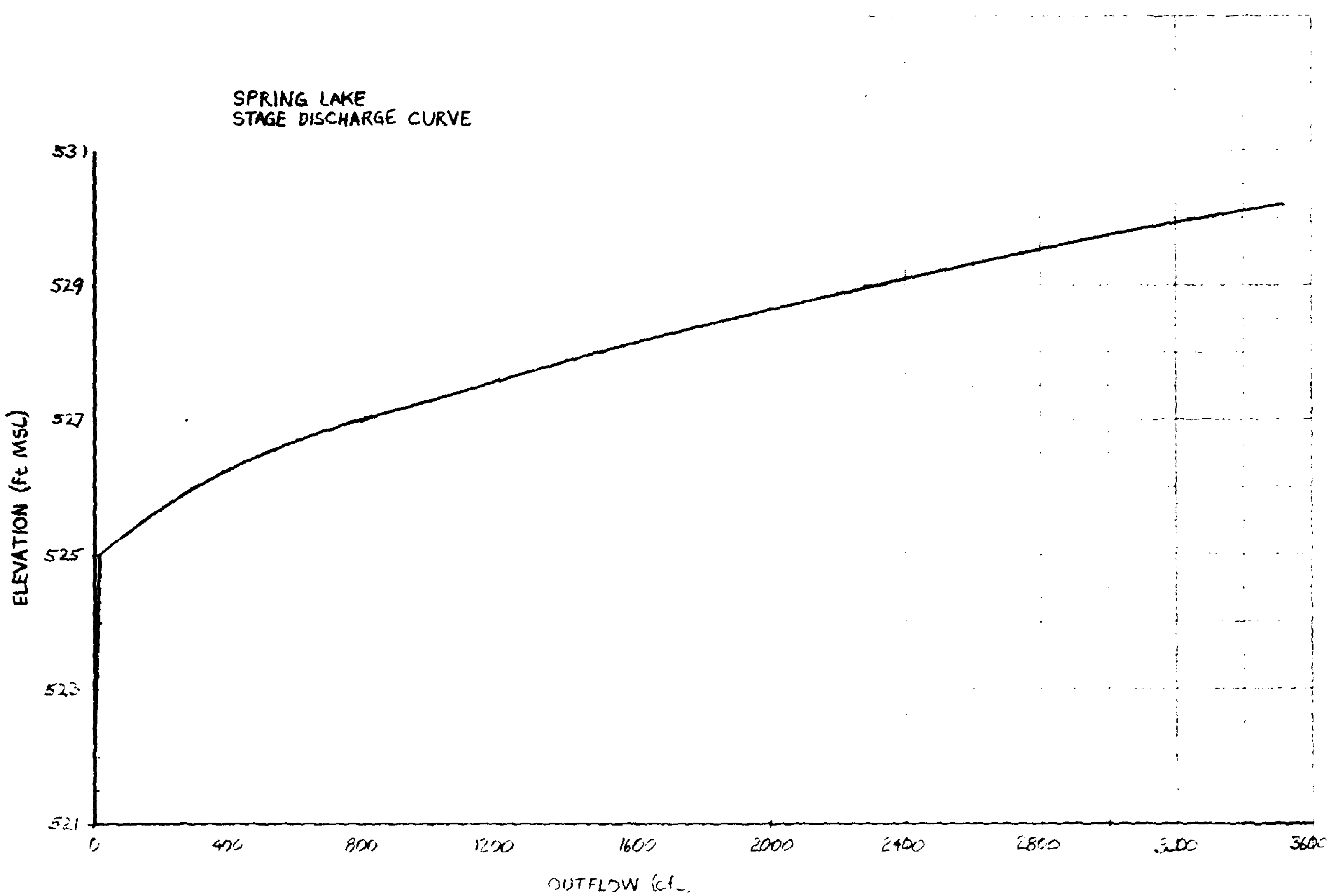
E.S. [illegible] FROM FIELD [illegible]

HEIGHT Ft.	AREA (Ac)	STORAGE (Aft)	STORAGE (dsf)	S/Δt (.2hr cfs)	OUTFLOW (cfs)	[illegible]
0	11.0	0	0	0	0	0
.5	11.5	5.6	2.84	341	8.5	[illegible]
1.0	11.9	11.5	5.77	[illegible]	16.7	14[illegible]
3.0	13.8	37.2	18.75	2250	18.0	451[illegible]
4.0	14.7	51.4	25.91	3109	18.6	623[illegible]
5.0	15.6	66.6	33.5[illegible]	4030	288	8347
6.0	16.5	82.5	41.59	4991	796	10[illegible]
8.0	18.4	117.6	59.29	7115	2319	1[illegible]49
9.2	19.5	140.3	70.13	8488	3519	20494


SPRING LAKE
ROUTING CURVE
Δt = 0.20HR
OUTFLOW (cfs)
250
200
150
100
50
0
0
1000
2000
3000
4000
5000
6000
7000
8000
2S/Δt + O (cfs)


SPRING LAKE
ROUTING CURVE
Δt = 0.20 HR
3000
2000
1000
0
OUTFLOW (cfs)
8000
10000
12000
14000
16000
18000
20000
2S/Δt + O (cfs)

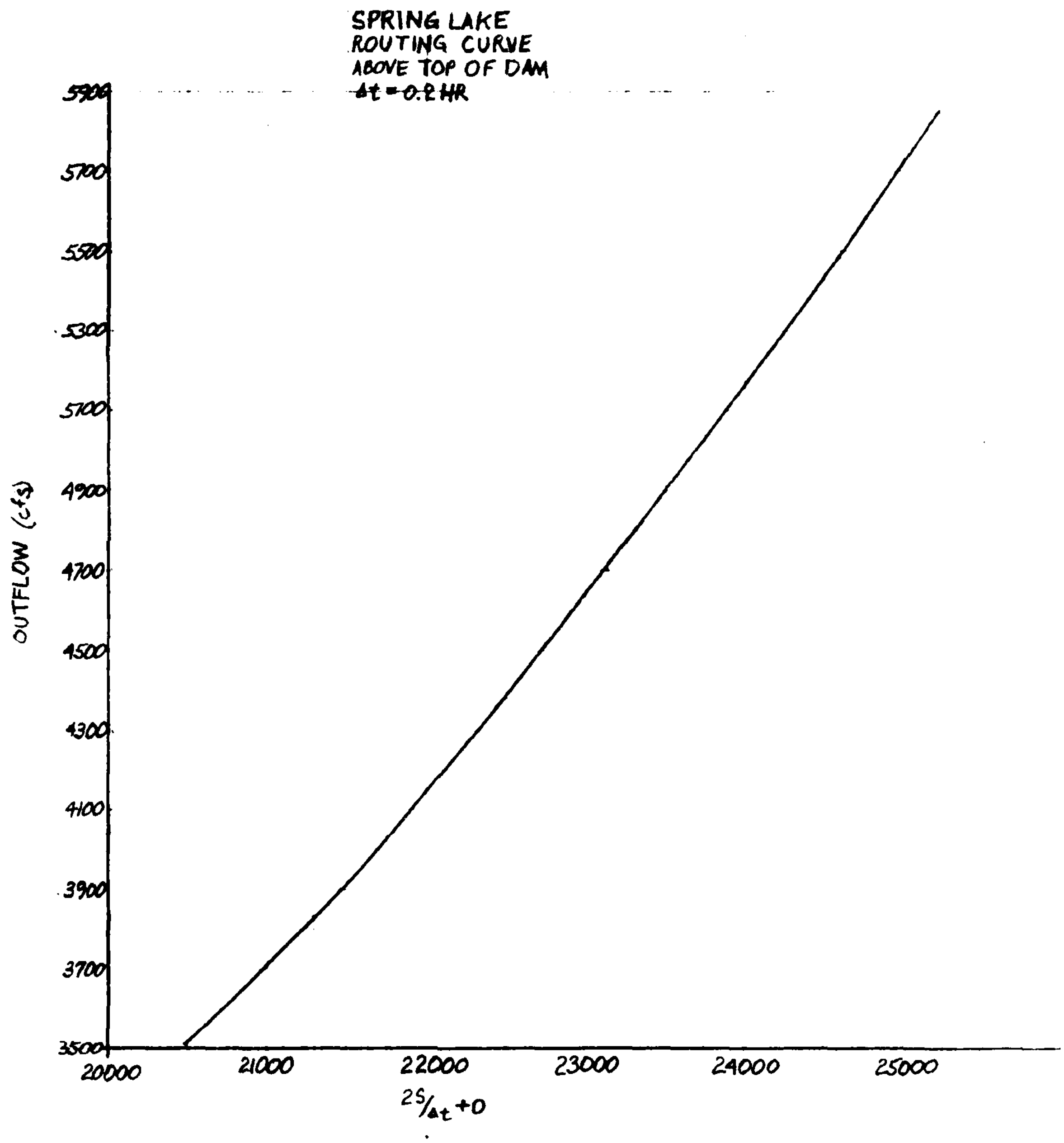
46 1240



SPRING LAKE
STAGE DISCHARGE CURVE
ELEVATION (Ft MSL)
531
529
527
525
523
521
0
400
800
1200
1600
2000
2400
2800
3200
3600
OUTFLOW (cf

SPRING LAKE ABOVE TOP of DAM RATING 26 MAY 81

HEIGHT (Ft)	AREA (Ac)	STORAGE (Ac ft)	STORAGE (DSF)	S/Δt (.2hr, cfs)	OUTFLOW (cfs)	2S/Δt + O
9.2	19.5	140.3	70.73	8488	3516	20494
9.4	19.7	144.3	72.75	8729	3936	21215
9.8	20.1	152.4	76.83	9219	4703	23142
10.2	20.4	160.1	80.74	9688	5844	25221



SPRING LAKE
ROUTING CURVE
ABOVE TOP OF DAM
Δt = 0.2 HR
OUTFLOW (cfs)
5900
5700
5500
5300
5100
4900
4700
4500
4300
4100
3900
3700
3500
20000
21000
22000
23000
24000
25000
2S/Δt + O

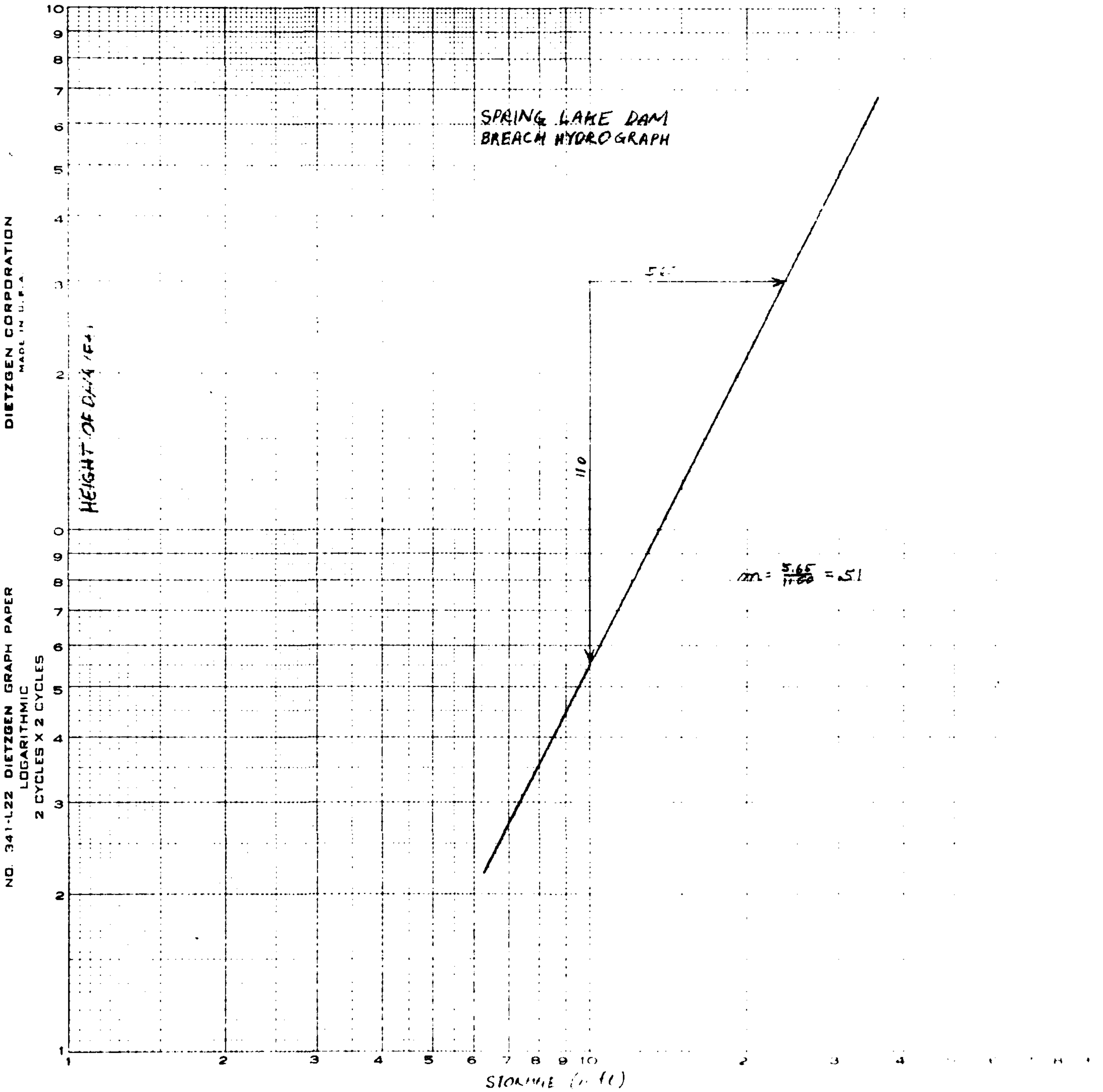
SPRING LAKE DAM   BREACH HYDROGRAPH   26 MAY 81   [illegible]

$m = \frac{5.65}{1100} = .51$

$Q_{max} = CLH^{3/2}$ $L = h = 19.4'$ $C = 3.2$

$= 5305$ cfs

$\frac{Q}{Q_m}$						
1.00	0	0	5305	1410	6715	25
.80	2	.03	4244	1240	5484	
.60	4	.06	3183	1020	4203	
.40	9	.15	2122	850	2972	
.20	23	.37	1061	612	1673	
.10	50	.81	531			



SPRING LAKE DAM
BREACH HYDROGRAPH
HEIGHT OF DAM (FT)
STORAGE
56
110
m = 5.65/11.00 = .51
DIETZGEN CORPORATION
MADE IN U.S.A.
NO. 341-L22 DIETZGEN GRAPH PAPER
LOGARITHMIC
2 CYCLES X 2 CYCLES

OLD HICKORY LAKE   INFLOW HYDROGRAPH   25 MAR 81

D.A. UNCONTROLLED $= 167\ Ac = .26\ Mi^2$
CONTROLLED $= 187\ Ac = .29\ Mi^2$
T[illegible]TAL $= 354\ Ac = .55\ Mi^2$

NPA $= 234\ Ac$
[illegible] SOIL [illegible] RU[illegible] (B), LEXINGTON (B), [illegible]
COVER [illegible]
CN = 76 AMC II [illegible] AMC III
[illegible]
[illegible] = [illegible]
REACH [illegible] = [illegible] ft
[illegible] 14 %

AMC II
$L = .118\ hr$
$T_c = .197\ hr$
$T_p = .138\ hr$

PMP = 29.7 IN
Q = 26.2 IN

HYDROGRAPH FAMILY #1
$T_o = 5.7\ hr$
$T_o/T_p = 41.3$
REV $T_o/T_p = 36$
REV $T_p = .158\ hr$
$q_p = 798$ cfs/in
$Q_{qp} = 20898$ cfs

q_c MAX = 3699 cfs @ 2.15 hr

P_{100}
$V_1 = (4.25 \times 354)\frac{1}{12} = 125.4$ Ac Ft.

[illegible] III
$L = .077\ hr$
$T_c = .128\ hr$
$T_p = .089\ hr$

$P_{100} = 5.5$ IN
Q = 4.25 IN

HYDROGRAPH FAMILY #2
$T_o = 5.35$ hr
$T_o/T_p = 60.1$
REV $T_o/T_p = 50$
REV $T_p = .107$ hr
$q_p = 1180$ cfs/IN
$Q_{qp} = 5016$ cfs

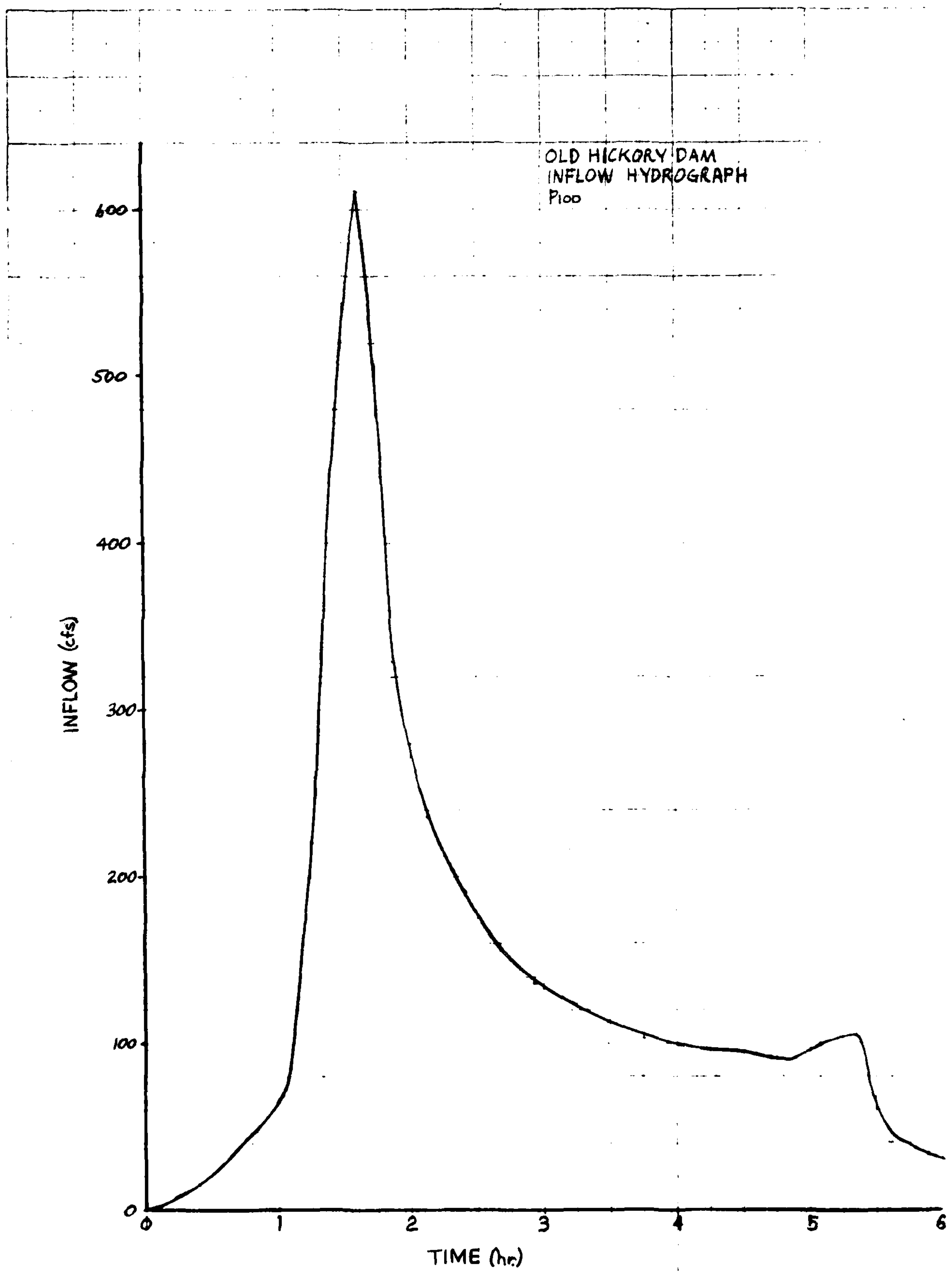
q_c max = 594 cfs @ 1.61 hr

OLD HICKORY LAKE | P_{100} INFLOW HYDROGRAPH 25 MAR 81 gam

Q_{qp} = 5016 cfs T_P = .107 hr

HYDROGRAPH FAMILY # 2 $T_o/T_p = 50$

LINE No.	t/T_o	TIME (hr)	q_c/q_p	q_c (cfs)		
1	0	0	0	0	0	0
2	2.50	.27	.0018	9	0	9
3	5.00	.54	.0047	24	0	24
4	7.50	.80	.0087	44	2	46
5	10.00	1.07	.0145	73	3	76
6	12.50	1.34	.0615	308	8	316
7	15.00	1.61	.1184	594	17	611
8	17.50	1.87	.0621	311	18	329
9	20.00	2.14	.0433	217	19	236
10	22.50	2.41	.0342	172	19	191
11	25.00	2.68	.0274	137	19	156
12	27.50	2.94	.0234	117	19	136
13	30.00	3.21	.0209	105	19	124
14	32.50	3.48	.0187	94	19	113
15	35.00	3.75	.0167	84	19	103
16	37.50	4.01	.0159	80	19	99
17	40.00	4.28	.0153	77	19	96
18	42.50	4.55	.0147	74	19	93
19	45.00	4.82	.0142	71	19	90
20	47.50	5.08	.0136	68	32	100
21	50.00	5.35	.0131	66	41	105
22	52.50	5.62	.0008	4	42	46
23	55.00	5.89	0	0	34	34


OLD HICKORY DAM
INFLOW HYDROGRAPH
P100
INFLOW (cfs)
600
500
400
300
200
100
0
TIME (hr)
0
1
2
3
4
5
6

OLD HICKORY LAKE DAM | PIOO ROUTING | gem | 2 JUNE 81

TIME (hr)	INFLOW (cfs)	2S/Δt − O	2S/Δt + O	OUTFLOW (cfs)
0	0	0	0	0
.2	6	6	6	0
.4	16	28	28	0
.6	28	72	72	0
.8	46	145	146	.5
1.0	64	253	255	1
1.2	168	481	485	2
1.4	428	1068	1077	4.5
1.6	611	2085	2107	11
1.8	432	2087	3128	20.5
2.0	276	3741	3795	27
2.2	224	4177	4241	32
2.4	190	4520	4591	35.5
2.6	166	4800	4876	38
2.8	148	5033	5114	40.5
3.0	134	5230	5314	42.5
3.2	124	5401	5488	43.5
3.4	116	5551	5641	45
3.6	110	5685	5777	46
3.8	104	5805	5899	47
4.0	100	5913	6009	48
4.2	96	6012	6109	48.5
4.4	96	6106	6204	49
4.6	93	6195	6295	50
4.8	90	6277	6378	50.5
5.0	94	6359	6461	51
5.2	102	6451	6555	52
5.4	98	6546	6651	52.5
5.6	48	6587	6692	52.5
5.8	36	6566	6671	52.5
6.0	30		6632	52

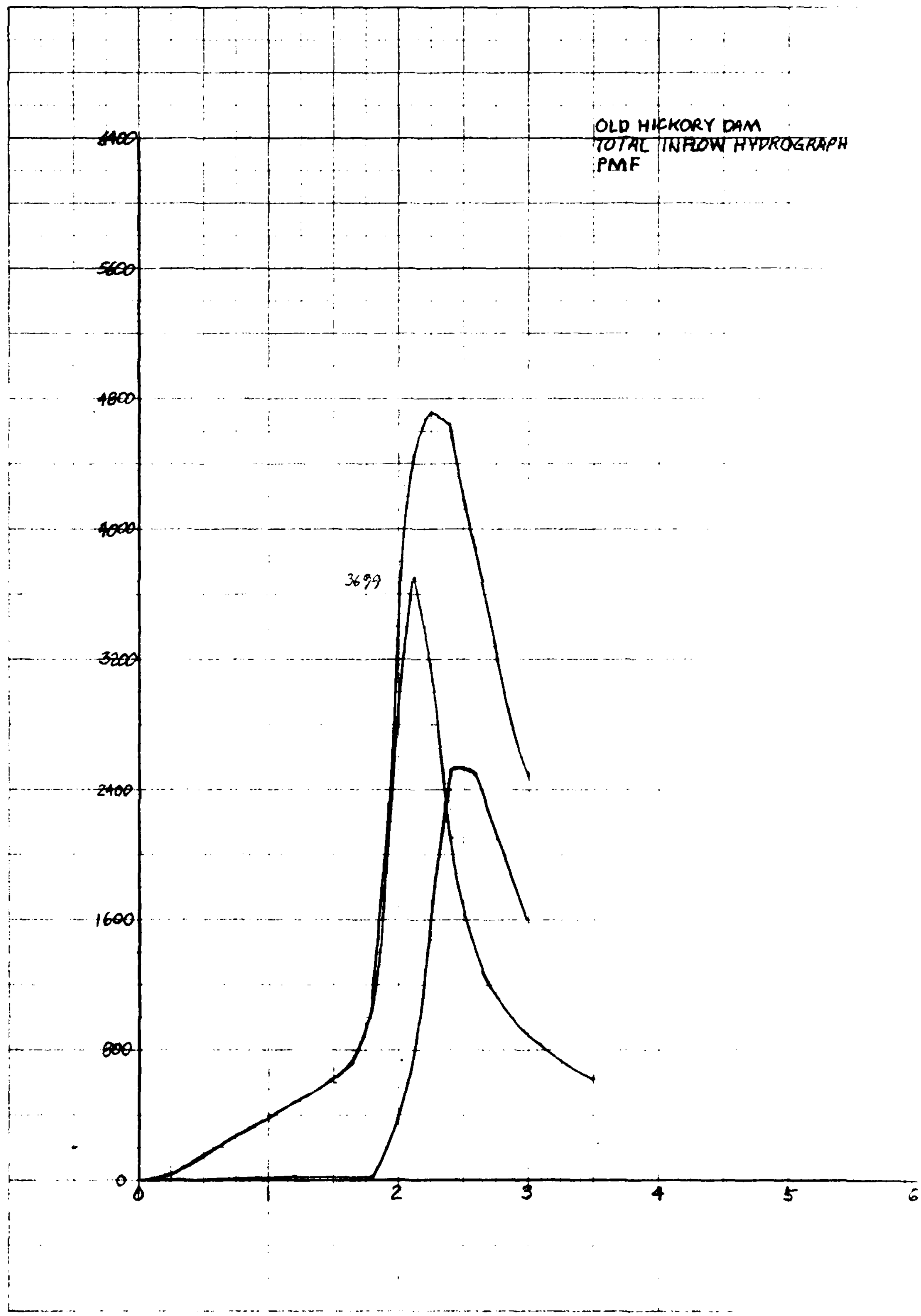
Passes no flow in E.S.

OLD HICKORY LAKE PMF INFLOW HYDROGRAPH 25 MAR 81 gm

$Q_{qp} = 20898$ $T_p = .158 hr$

HYDROGRAPH FAMILY #1 $T_0/T_p = 36$

LINE No.	t/T_p	TIME (hr)	q_c/q_p	q_c (cfs)
1	0	0	0	0
2	1.70	.27	.002	42
3	3.40	.54	.008	167
4	5.10	.81	.014	293
5	6.80	1.08	.020	418
6	8.50	1.35	.026	543
7	10.20	1.62	.033	690
8	11.90	1.88	.077	1609
9	13.60	2.12	.177	3699
10	15.30	2.42	.101	2111
11	17.00	2.69	.058	1212
12	18.70	2.96	.044	920
13	20.40	3.23	.036	752
14	22.10	3.50	.030	627
15	23.80	3.77	.027	564
16	25.50	4.04	.024	502
17	27.20	4.31	.022	460
18	28.90	4.68	.020	418
19	30.60	4.85	.018	376
20	32.30	5.11	.017	355
21	34.00	5.39	.017	355
22	35.70	5.65	.017	355
23	37.40	5.92	.004	84
24	39.10	6.19	.002	42
25	40.80	6.46	0	0


OLD HICKORY DAM
TOTAL INFLOW HYDROGRAPH
PMF
6400
5600
4800
4000
3699
3200
2400
1600
800
0
0
1
2
3
4
5
6

23 JAN (1+4)

OLD HICKORY DAM | PMF ROUTING 26 MAR 81 gcm

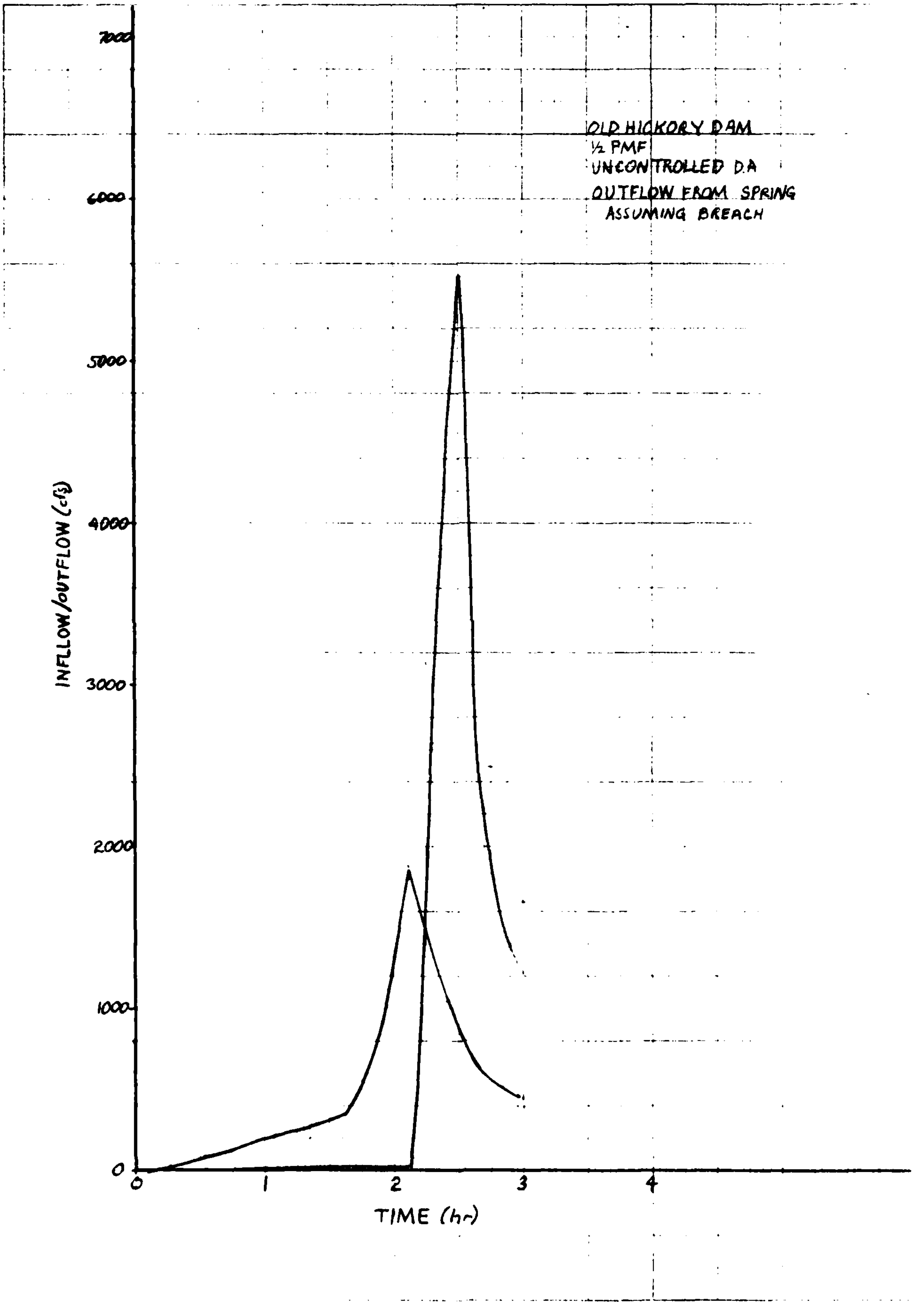
TIME (hr)	INFLOW (cfs)	2S/Δt − O	2S/Δt + O	OUTFLOW (cfs)	
0	0	0	0	0	
.25	35	35	35	0	
.50	150	220	220	0	
.75	270	636	640	2	
1.00	375	1267	1281	7	
1.25	495	2103	2137	17	
1.50	630	3168	3228	30	
1.75	940	4644	4738	47	
2.00	3460	8154	9044	445	
2.25	4710	12324	16324	2000	
2.50	4180	14510	21214	3352	
2.75	3240	14810	21930	3560	
3.00	2490		20540	3160	PEAK PASSES

OLD HICKORY DAM | ½ PMF ROUTING | 26 MAY 81 | gem

INCLUDING BREACH of SPRING LAKE DAM

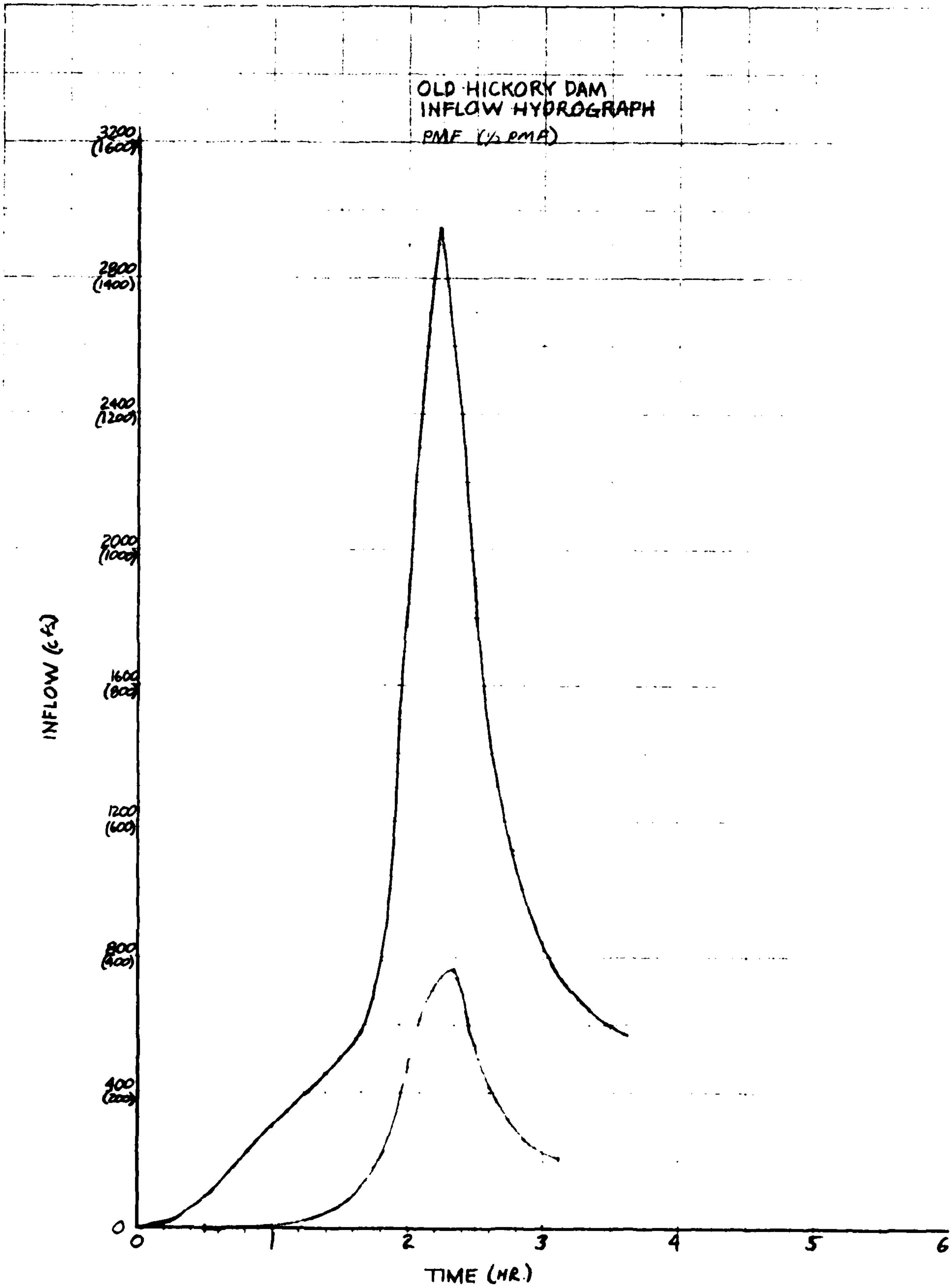
TIME (hr)	INFLOW (cfs)	2S/Δt − O	2S/Δt + O	OUTFLOW (cfs)	
0	0	0	0	0	
.25	20	20	20	0	
.50	75	115	115	0	
.75	130	320	320	0	
1.00	200	646	650	2	
1.25	250	1086	1096	5	
1.50	330	1642	1666	12	
1.75	540	2468	2512	22	
2.00	1360	4282	4368	43	
2.25	3130	8080	8772	346	
2.50	7595	13425	18805	2690	
2.75	2941	15761	23961	4100	
3.00	1874	14236	20576	3170	PEAK PASSES

46 1240

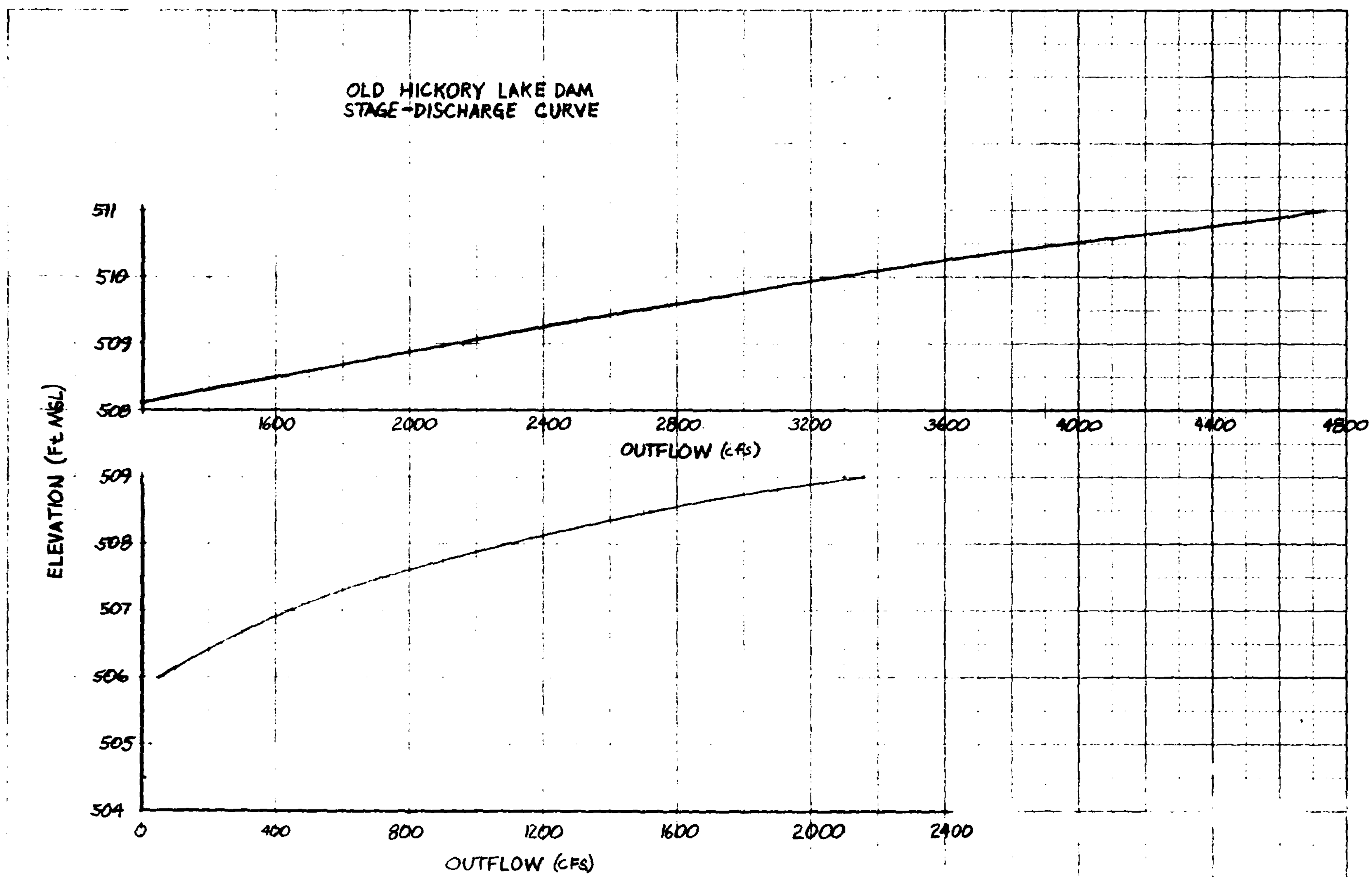

OLD HICKORY DAM
½ PMF
UNCONTROLLED D.A
OUTFLOW FROM SPRING
ASSUMING BREACH
7000
6000
5000
4000
3000
2000
1000
0
INFLLOW/OUTFLOW (cfs)
0
1
2
3
4
TIME (hr)

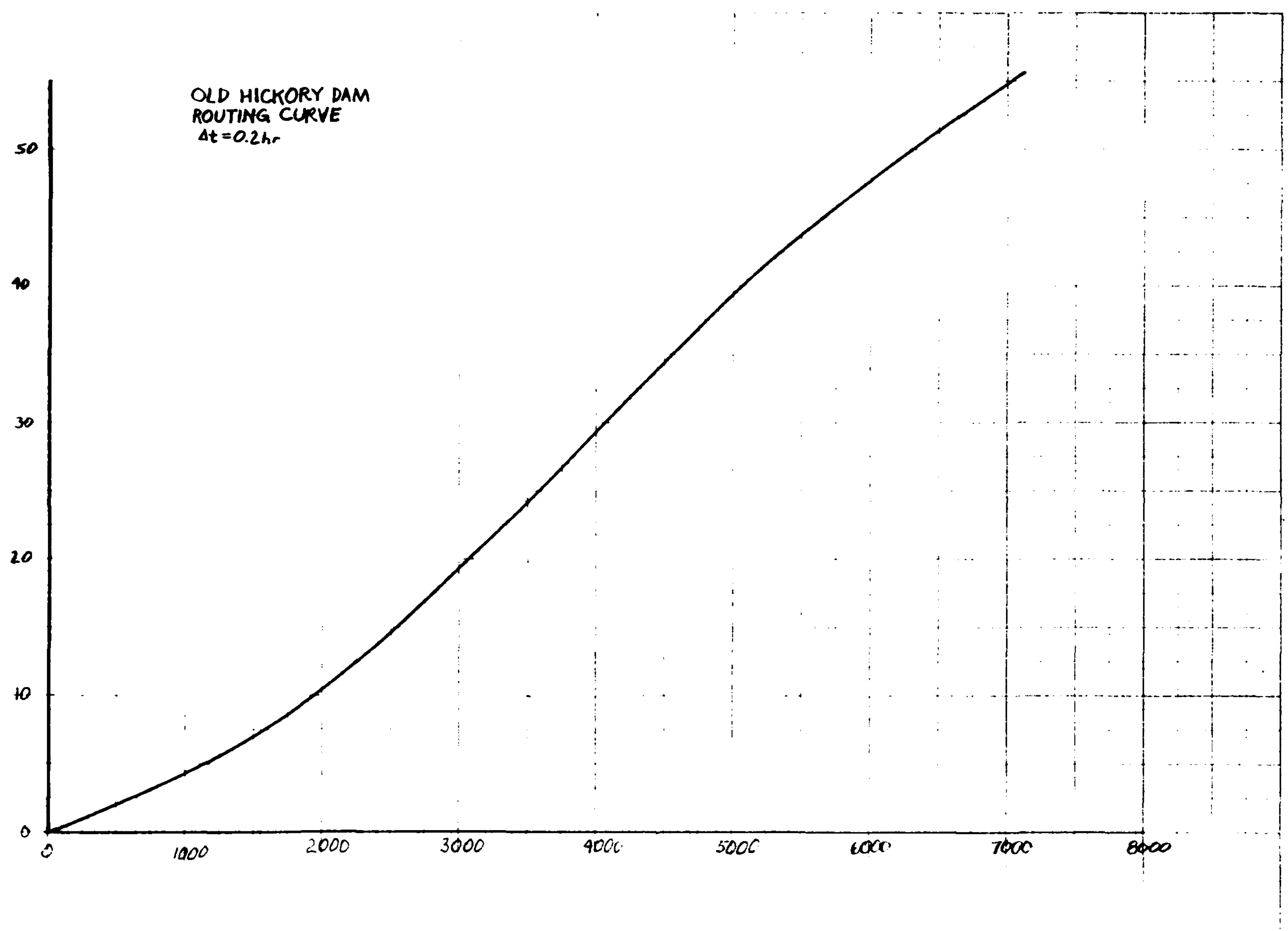
OLD HICKORY DAM | ½ PMF ROUTING ASSUMING NO BREACH OF SPRING | 26 MAY 81

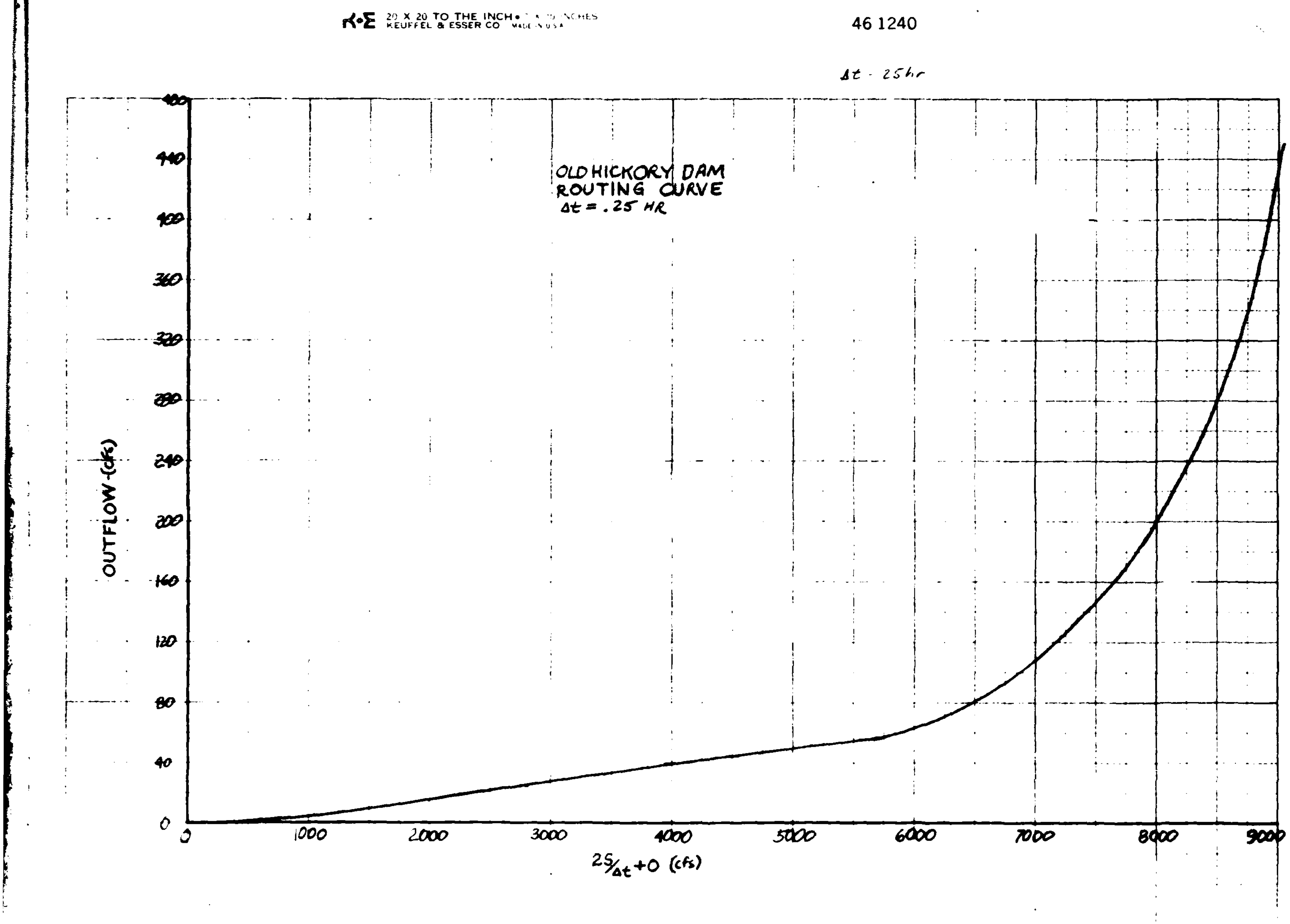
TIME (hr)	INFLOW (cfs)	2S/Δt − O	2S/Δt + O	OUTFLOW (cfs)
0	0	0	0	0
.25	20	20	20	0
.50	75	115	115	0
.75	130	320	320	0
1.00	200	646	650	2
1.25	250	1086	1096	5
1.50	330	1642	1666	12
1.75	540	2468	2512	22
2.00	1360	4282	4368	43
2.25	3130	8080	8772	346
2.50	6400	12890	17610	2360
2.75	2490	14500	21780	3640
3.00	1660	13330	18650	2660


OLD HICKORY DAM
INFLOW HYDROGRAPH
PMF (½ PMF)
INFLOW (cfs)
3200 (1600)
2800 (1400)
2400 (1200)
2000 (1000)
1600 (800)
1200 (600)
800 (400)
400 (200)
0
0 1 2 3 4 5 6
TIME (HR.)

K·E 20 X 20 TO THE INCH · KEUFFEL & ESSER CO.　　46 1240

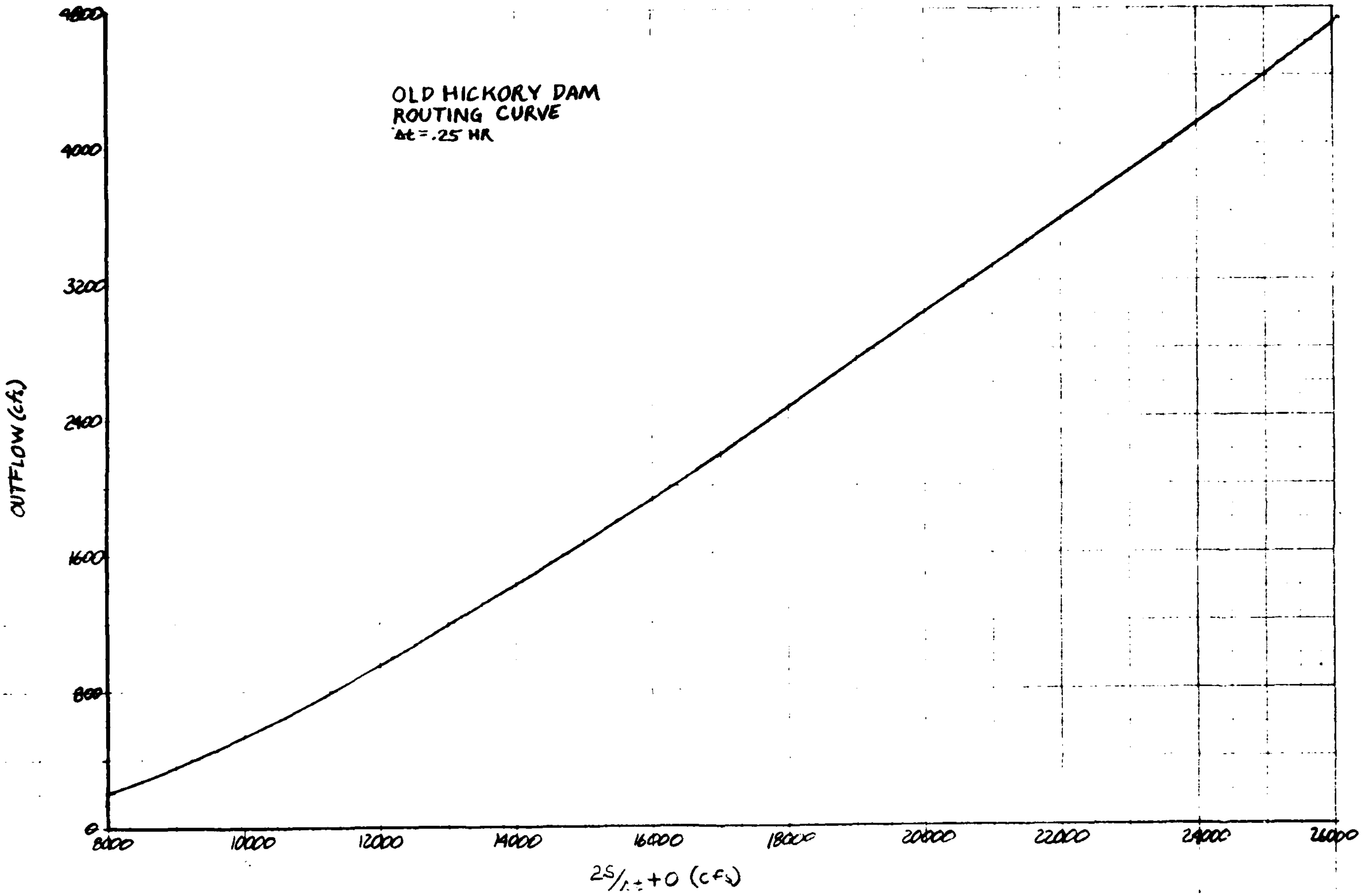



OLD HICKORY DAM
ROUTING CURVE
Δt = 0.2 hr
0
10
20
30
40
50
0
1000
2000
3000
4000
5000
6000
7000
8000



K&E 20 X 20 TO THE INCH
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 1240
Δt - .25hr
OLD HICKORY DAM
ROUTING CURVE
Δt = .25 HR
OUTFLOW-(cfs)
0
40
80
120
160
200
240
280
320
360
400
440
480
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
2S/Δt+O (cfs)

46 1240


OLD HICKORY DAM
ROUTING CURVE
Δt = .25 HR
OUTFLOW (cfs)
4800
4000
3200
2400
1600
800
0
8000
10000
12000
14000
16000
18000
20000
22000
24000
26000
2S/Δt + O (cfs)

OLD HICKORY DAM | SPILLWAY RATING | 4/MAR/81 | JOM.

ELEVATION (Ft MSL)	SERVICE SPILLWAY				EMERGENCY SPILLWAY		TOTAL OUTFLOW
	WEIR FLOW		PIPE FLOW				
	h (ft)	Q (cfs)	h (ft)	Q (cfs)	H_m (ft)	Q (cfs)	Q_t (cfs)
504	0	0					0
504.5	0.5	8.5					8.5
505	1.0	24.2	14.5	~~53.8~~			24.2
506	2.0	~~68.3~~	15.5	55.6	0	0	55.6
507			16.5	57.3	1	392.5	450
509			18.5	60.7	3	2098.4	2159
511			20.5	63.9	5	4667.8	4732

SERVICE SPILLWAY

WEIR FLOW $Q = CLH^{3/2}$ $C = 3.02$ $L = 8$ ft KINGS HANDBOOK § 5

PIPEFLOW $Q = Ca\sqrt{2gh}$ $C = .56$ $a = \pi(1)^2$ ft² KINGS HANDBOOK § 4

EMERGENCY SPILLWAY $Q = C_2 b H_m^{3/2}$ $b = 125$ Ft $z = 3$ KINGS HANDBOOK § 8

C_2 SEE TABLE 8-7

HEIGHT (Ft)	AREA (Ac)	STORAGE (Acft)	STORAGE (DSF)	S/Δt (.25 hr cfs)	OUTFLOW (cfs)	2S/Δt + O
0	28.3	0	0	0	0	0
.5	28.7	14.25	7.18	690	8.5	1388
1.0	29.2	28.75	14.49	1391	24.2	2807
2.0	30.1	58.4	29.44	2827	55.6	5709
3.0	31.0	88.95	44.84	4305	450	9060
5.0	32.8	152.75	77.01	7393	2159	16945
7.0	34.6	220.15	110.99	10655	4732	26042

CHANCELLOR + SONS DAM | PMF INFLOW HYDROGRAPH | 20 MAR 81 | gem

$Q_{qp} = 4872$ cfs $\quad T_p = .156$ hr

HYDROGRAPH FAMILY # 1 $\quad T_0/T_p = 36$

No.	t/T_p	t (hr)	q/q_p	½ PMF q (cfs)	PMF q (cfs)
1	0	0	0	0	0
2	1.7	.27	.002	5	10
3	3.4	.53	.008	20	39
4	5.1	.80	.014	34	68
5	6.8	1.06	.020	49	97
6	8.5	1.33	.026	63	127
7	10.2	1.59	.033	80	161
8	11.9	1.86	.077	188	375
9	13.6	2.12	.177	431	862
10	15.3	2.39	.101	246	492
11	17.0	2.65	.058	141	283
12	18.7	2.92	.044	107	214
13	20.4	3.18	.036	88	175
14	22.1	3.45	.030	73	146
15	23.8	3.71	.027	66	132
16	25.5	3.98	.024	58	117
17	27.2	4.24	.022	54	107
18	28.9	4.51	.020	49	97
19	30.6	4.77	.018	44	88
20	32.3	5.04	.017	41	83
21	34.0	5.30	.017	41	83
22	35.7	5.57	.017	41	83
23	37.4	5.83	.004	10	19
24	39.1	6.10	.002	5	10
25	40.8	6.36	0	0	0

$3868 \times .27 \times \frac{3600}{43560} = 84.8$ Ac-ft

$25.4 \times 40 \times \frac{1}{12} = 84.7$ Ac-ft

gm

CHANCELLOR + SON DAM	PMF ROUTING	20 MAR 81	gam

TIME (hr)	INFLOW (cfs)	2S/Δt − O	2S/Δt + O	OUTFLOW (cfs)	
0	0	0	0	0	
.26	10	10	10	0	
.52	36	56	56	0	
.78	65	155	157	1	
1.04	94	306	314	4	
1.30	125	461	525	32	
1.56	165	587	751	82	
1.82	315	617	1067	225	
2.08	862	564	1799	615	
2.34	620	518	2046	764	
2.60	308	616	1446	415	PEAK PA[illegible]
2.86	226	626	1150	262	
3.12	183		1035	207	
3.38	152				
3.64	136				
3.90	121				
4.16	109				
4.42	100				
4.68	91				
4.94	84				

CHANCELLOR + SON DAM | ½ PMF ROUTING | 20 MAR 81 | gam

TIME (hr)	INFLOW (cfs)	2S/Δt − O	2S/Δt + O	OUTFLOW (cfs)	
0	0	0	0	0	
.26	5	5	5	0	
.52	18	28	28	0	
.78	33	77	79	1	
1.04	47	155	157	1	
1.30	62	258	264	3	
1.56	82	376	402	13	
1.82	155	517	613	48	
2.08	431	623	1103	240	
2.34	310	624	1364	370	
2.60	158	622	1092	235	PEAK PASSES
2.86	113	529	893	132	
3.12	91		733	76	
3.38	77				
3.64	68				
3.90	61				
4.16	55				
4.42	50				
4.68	45				
4.94	42				

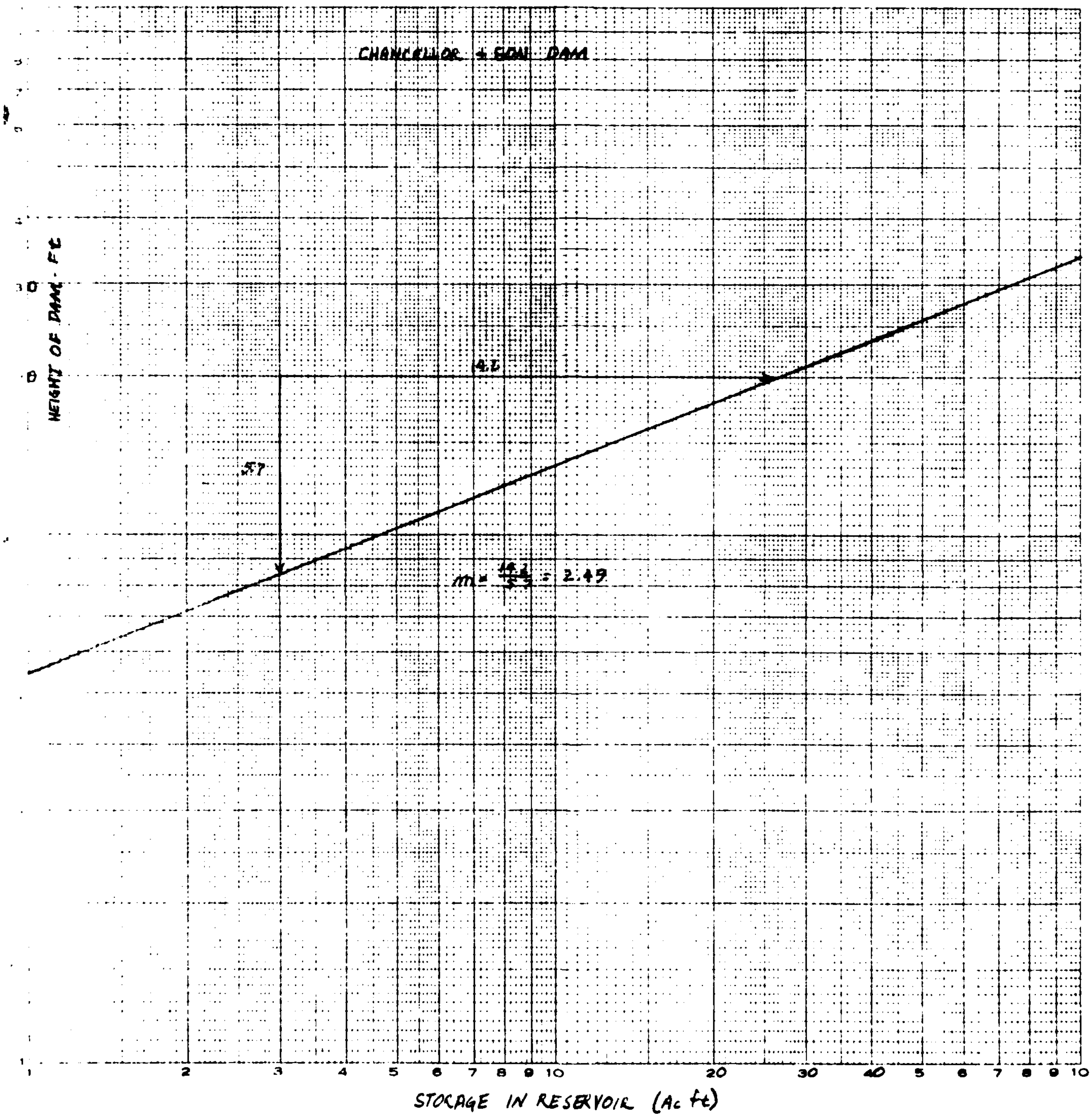
ASSUME INSTANTANEOUS SQUARE BREACH WIDTH = HEIGHT of DAM

$Q_{max} = 3.2\,Lh^{3/2}$ $L = 25$ $h = 24.35$

$= 9027$ cfs.

$$T_R = \frac{46.4 \text{ Acft} \times 43560 \text{ ft}^3/\text{ac}}{9027 \text{ cfs}} = 223.9 \text{ sec.}$$

$\frac{Q}{Q_{max}}$	$\frac{t(10^5)}{t_R}$	t (hours)	Q (cfs) BREACH	Q (cfs) INFLOW
1.0	0	0	9027	310
.8	6.2	.014	7222	295
.6	14.5	.032	5416	276
.4	25.3	.057	3611	250
.2	44.8	.100	1805	205
.1	64	.14	903	175



CHANCELLOR + SON DAM
14.2
5.7
m = 14.2/5.7 = 2.49
HEIGHT OF DAM - Ft
10
1
2
3
4
5
6
7
8
9
10
20
30
40
5
6
7
8
9
10
STORAGE IN RESERVOIR (Ac ft)

CHANCELLOR + SONS DAM | P_{100} INFLOW HYDROGRAPH | 20 MAR 81

$Q_{qp} = 1116$ cfs $\quad T_p = .103$ hr

HYDROGRAPH FAMILY # 2 $\quad T_o/T_p = 50$

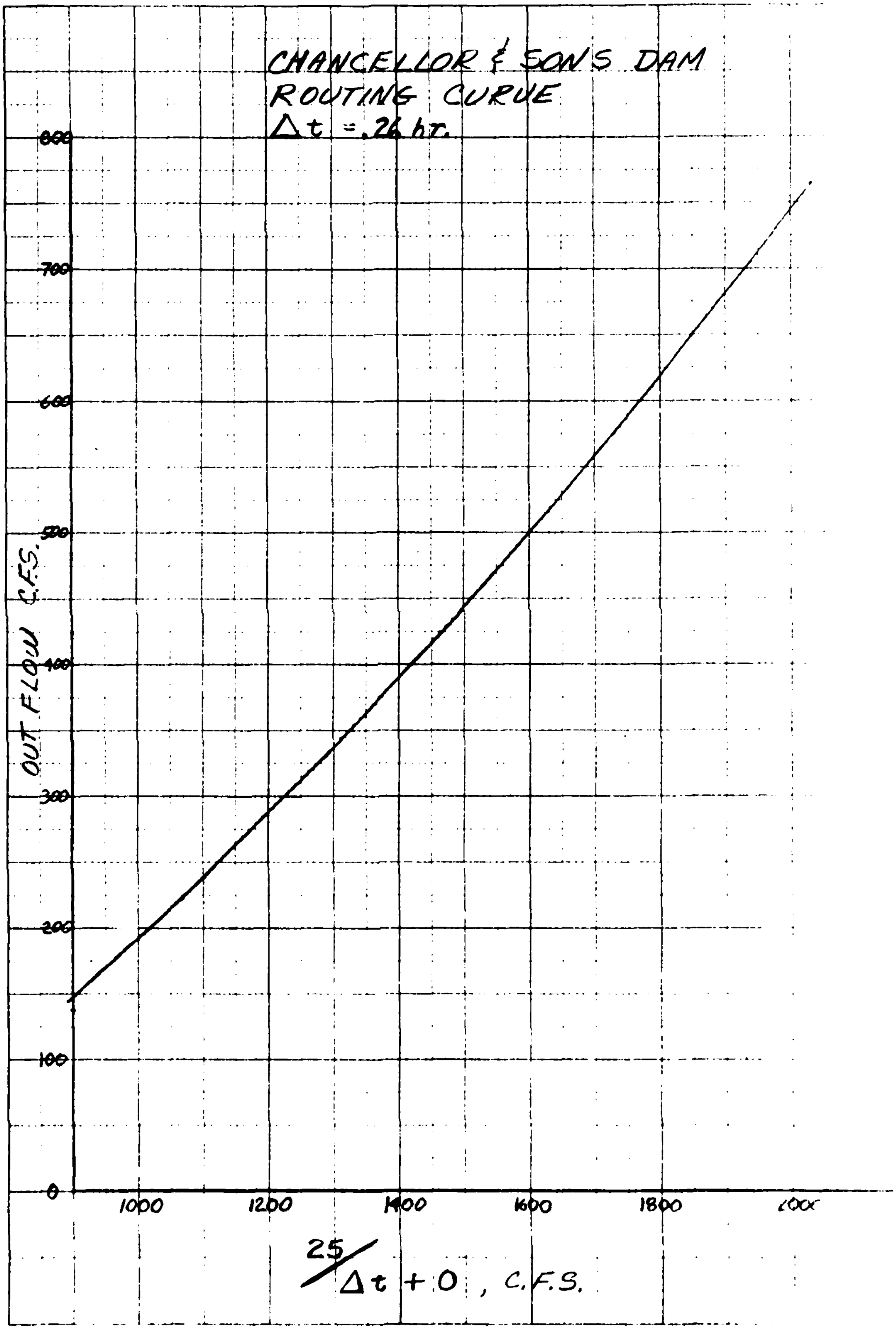
t/T_p	t (hr)	q_c/q_p	q (cfs)
0	0	0	0
2.5	.26	.0018	2
5.0	.52	.0047	5
7.5	.77	.0087	10
10.0	1.03	.0145	16
12.5	1.29	.0615	69
15.0	1.55	.1189	132
17.5	1.80	.0621	69
20.0	2.06	.0433	48
22.5	2.32	.0342	38
25.0	2.58	.0274	31
27.5	2.83	.0234	26
30.0	3.09	.0209	23
32.5	3.35	.0187	21
35.0	3.61	.0167	19
37.5	3.86	.0159	18
40.0	4.12	.0153	17
42.5	4.38	.0147	16
45.0	4.64	.0142	16
47.5	4.89	.0136	15
50.0	5.15	.0131	15
52.5	5.41	.0008	1
55.0	5.67	0	0

$607_{cfs} \times .26_{hr} \frac{3600\ sec}{43560\ ft^2/ac}$ 12.9 Ac ft

$3.8\ IN \times 40\ Ac \frac{1\ F}{12\ IN} = 12.7$ Ac ft

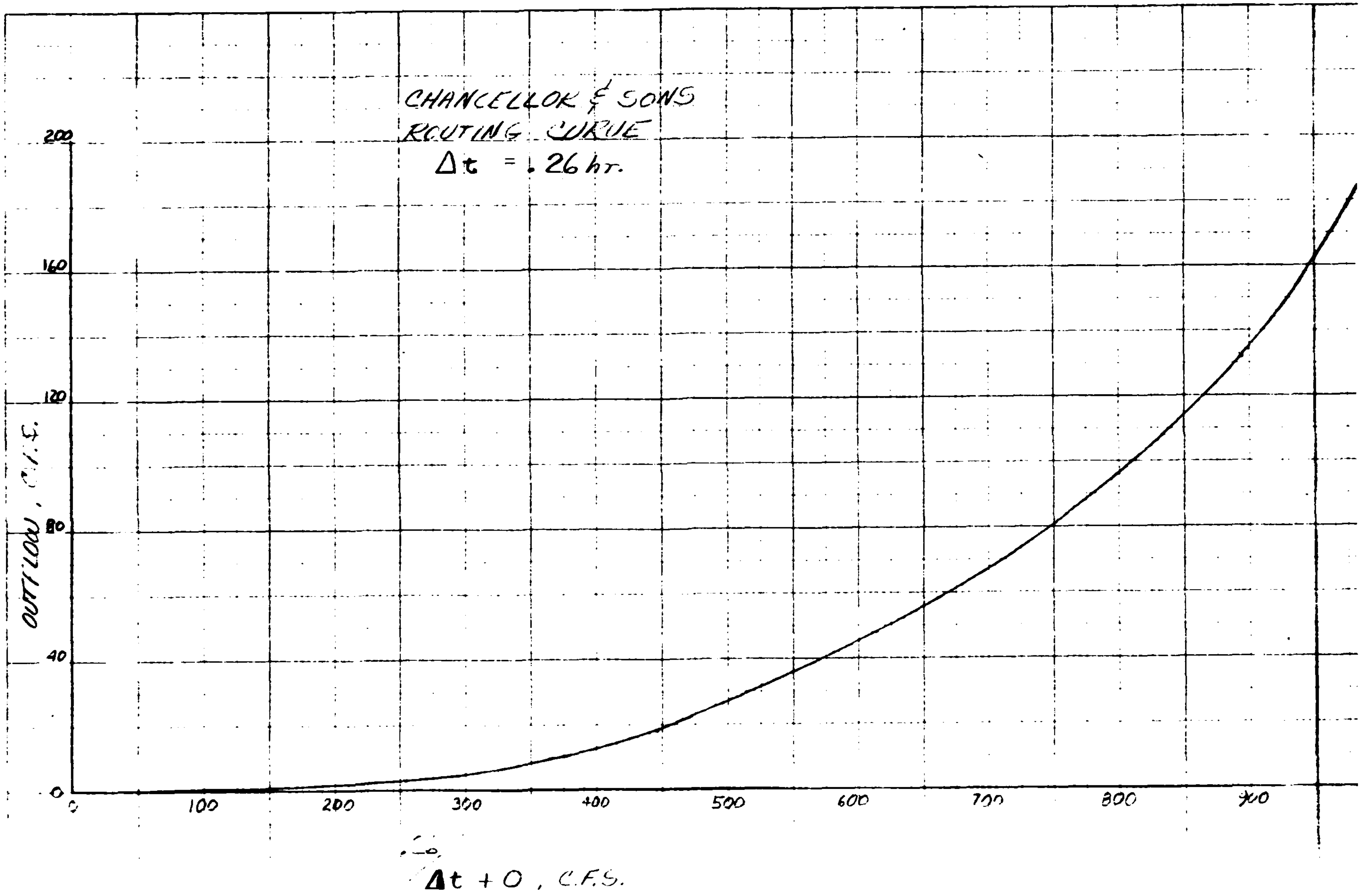
CHANCELLOR + SONS DAM | P100 ROUTING | 20 MAR 81

TIME (hr)	INFLOW (cfs)	2S/Δt − O	2S/Δt + O	OUTFLOW (cfs)	
0	0	0	0	0	
.26	2	2	2	0	
.52	5	9	9	0	
.78	9	23	23	0	
1.04	17	49	49	0	
1.30	75	139	141	1	
1.56	132	330	346	8	
1.82	66	464	528	32	
2.08	47	495	577	41	
2.34	37	495	579	42	
2.60	31	485	563	39	PEAK PASSE
2.86	26	472	542	35	
3.12	23	459	521	31	
3.38	21	449	503	27	
3.64	19	439	489	25	
3.90	18	430	476	23	
4.16	17	421	465	22	
4.42	16	414	454	20	
4.68	16	410	446	18	
4.94	15	405	441	18	
5.20	14	400	434	17	
5.46	1	387	415	14	
5.72	0	364	388	12	
5.98	0		364	10	
6.24	0		344	8	
6.50			328	6	
6.76			314	6	



K•E 20 X 20 TO THE INCH • KEUFFEL & ESSER CO.

46 1240


CHANCELLOR & SONS
ROUTING CURVE
Δt = .26 hr.
OUTFLOW, C.F.S.
0
40
80
120
160
200
0
100
200
300
400
500
600
700
800
900
2S/Δt + O, C.F.S.

APPENDIX F

CORRESPONDENCE

Tennessee Department of

Conservation

Division of Water Resources

RAY BLANTON - GOVERNOR
B.R.ALLISON · COMMISSIONER

6213 Charlotte Ave(Suite 107) Nashville,Tennessee 37209 (615)741-1281
ROBERT A. HUNT DIRECTOR

MEMORANDUM

TO: Bob Hunt

FROM: Ed O'Neill

DATE: 12/ 9 /76

SUBJECT: Application No. 75-101-C

Name of Dam SPRING LAKE

HARDEMAN County

I have reviewed the plans, specifications and other material submitted for the subject dam. I find these submittals in compliance with the Safe Dams Act and issuance of a Certificate of Approval and Safety for OPERATION is recommended.

Damage potential category is ONE.

Date 12/2/76 Region WEST

INSPECTION REPORT

Name of Dam: SPRING County HARDEMAN

Owners Name: TERRA AQUA Quad. ______

Type Project: Existing ______ Application No. 75-101-C
New Construction ✓
Repair/Alteration ______
Removal ______

Type Inspection: Stage I ______
Stage II ______
Certificate ✓
Cursory ______
Preliminary Site Review ______

Damage Potential Category: One ✓ Two ______ Three ______ Undetermined ______

Inspection by: [signature]

Inspection Results:

ACCOMPANIED BY JAMES RAGON PE. & WOOD/ JENNE & STW, AND ARTHUR [illegible] FORMAN. DAM APPEARS FINISHED INCLUDING SOD. SOME TOUCH UP ON SPILLWAY MAY BE NESSARY IN SPRING.

Tennessee Department of
Conservation Division of Water Resources
RAY BLANTON - GOVERNOR
B.R.ALLISON · COMMISSIONER
6213 Charlotte Ave(Suite 107) Nashville,Tennessee 37209 (615)741-1281
ROBERT A. HUNT DIRECTOR

MEMORANDUM

TO: Bob Hunt

FROM: Ed O'Neill

DATE: 12/ 9 /76

SUBJECT: Application No. 76-101-C

Name of Dam OLD HICKORY LAKE

HARDEMAN County

I have reviewed the plans, specifications and other material submitted for the subject dam. I find these submittals in compliance with the Safe Dams Act and issuance of a Certificate of Approval and Safety for OPERATION is recommended.
Damage potential category is ONE .

Date 12/1/76 Region WEST

INSPECTION REPORT

Name of Dam: OLD HICKORY County HARDEMAN

Owners Name: TERRA AWA Quad.

Type Project: Existing ____ New Construction ✓ Repair/Alteration ____ Removal ____

Application No. 76-701-C

Type Inspection: Stage I ____ Stage II ____ Certificate ✓ Cursory ____ Preliminary Site Review ____

Damage Potential Category: One ✓ Two ____ Three ____ Undetermined ____

Inspection by: [signature]

Inspection Results:

ACCOMPANIED BY JAMES RAGON, OWNER TERRA AWA AND ARTHUR EWELL FOREMAN.

DAM APPEARS COMPLETE.

Date 2/14/79 | Region West

INSPECTION REPORT

Name of Dam: Spring | County: Hardeman

Owner's Name: ______ | Quad: 432SE

Type Project: | Application No. ______

Type Project	
Existing	X
New Construction	
Repair/Alteration	
Removal	

Type Inspection:

Type Inspection	
Phase I	
Phase II	
Certificate	X
Cursory	
Preliminary Site Review	

Phase I Reconnaissance ______

Damage Potential Category: One ___ Two ___ Three ___ Undetermined ___

Inspection by: George Moore and Troy Wedekind

Inspection Results:

The entrance channel of the emergency spillway has a large erosion gully and a moderately large gully runs down the left D/S embankment abutment contact area. These areas should be repaired and reseeded. Two possible wet areas were observed along the toe near each abutment. There is no wet area vegetation. These areas should be reinspected in dryer weather. Water has backed up behind the flap gates on the toe drains. According to information provided by Jerry Shide of Armco, there should be no back up of water behind the flap gate (Model 10-C). The gate and the area immediately in front of the gate should be cleared of any obstructions to the correct operation of the gate. This report is accompanied by photos.

PHOTO NO.1

PHOTO NO.2

PHOTO NO.3

Date 2/14/79

Region West

INSPECTION REPORT

Name of Dam: Old Hickory

County: Hardeman

Owner's Name: ____

Quad: 432SE

Type Project:

Application No. ____

Existing	X
New Construction	
Repair/Alteration	
Removal	

Type Inspection:

Phase I	
Phase II	
Certificate	X
Cursory	
Preliminary Site Review	

Phase I Reconnaissance ____

Damage Potential Category: One ___ Two ___ Three ___ Undetermined ___

Inspection by: George Moore and Troy Wedekind

Inspection Results:

An area of wetland vegetation and a small flow of water were located on the right downstream embankment toe. The flow did not appear to be carrying any material and is reportedly coming from a spring. The area should be monitored for any change in flow rate or turbidity. There is some minor erosion on the slopes. This should be stopped before it becomes worse. This report is accompanied by a photo.

PHOTO NO. 1

14 Feb 79 Old Hickory Dam Hardeman Co.

Wet area on the right abutment at the toe.

RAGON ENGINEERING COMPANY
CONSULTING ENGINEERS
725 WEST MARKET ST.
P. O. Box 347
BOLIVAR, TENNESSEE 38008

JAMES H. RAGON, P. E.

DON R. MOORE, BSCE; EIT
EDMOND B. O'NEILL, BSME
BOBBY L. TULLEY, BSAET

March 6, 1975

Mr. Robert A. Hunt
Tennessee Department of Conservation
Division of Water Resources
6213 Charlotte Ave.
Nashville, Tennessee 37209

Re: Spring Lake, Candlewood Lakes Subdivision

Dear Mr. Hunt:

Enclosed are hydrograph and flood routing data for Spring Lake. These data are for use with "The National Engineering Handbook - 4".

Concerning the toe drain, we are modifying our design as follows: a perforated pipe will be placed in a gravel trench and the gravel trench will be wrapped in Laurel Erosion Control Cloth Type II. Gravel will be clean, natural, and be proportioned such that the D_{85} size is equal to or greater than 1/2-inch (twice the diameter of the perforated holes).

Other items in your letter of February 14, 1975 have been corrected, and the plans are being returned under separate cover.

Sincerely yours,

James H. Ragon, P. E.

EBO/ct

Enc.

SPRING LAKE

CANDLEWOOD LAKES INC. ENGINEERING REPORT

ADDITION I TO SECTION II MARCH 6, 1975

HYDROGRAPH

Inflow hydrographs were obtained from the National Engineering Handbook, Section Four, "Emergency Spillways".

A 6-hour rainfall of 24 inches was chosen, which gives considerable safety factor for this structure. We classify this structure as Risk Category One.

Parameters needed to use the NEH - 4 hydrographs are as follows:

Drainage Area = 187 acres.

Rainfall = 24 inches (.8 PMP)

SCS Curve Number = 80

$$\frac{T_o}{T_p} = 75$$

Runoff = 21.5 inches.

Time of Concentration = $T_c = \left(\frac{11.9\left(\frac{1750}{5280}\right)^3}{116}\right)^{.385} = .10480$ hours.

NEH - 4, Page 21.67 yields 3595 cfs maximum inflow.

FLOOD ROUTING

The SCS UD (Upper Darby) method was used. Parameters needed for the UD data are:

V_I = 53.3 x Runoff (inches) x Drainage Area (square mile)

$V_I = 53.3\ (21.5)(.292) = 334.8$

Elevation of Emergency Crest = 525 feet msl.

V_{uf} = 65 AF

$V_{sp} = V_{te} - V_{uf} = (5.09 - 2.85)10^6\ ft^3 = 2.24 \times 10^6 = 51.42$ AF

<u>FLOOD ROUTING (continued)</u>

$$\frac{V_{sp}}{V_I} = \frac{51.42}{334.8} = .15$$

$$V_{tw(530)} = 9.5 \times 10^6 \ ft^3 = 218 \ AF$$

$$V_{sw} = V_{tw} - V_{uf} = 218 - 65 = 153 \ AF$$

$$\frac{V_{sw}}{V_I} = \frac{153}{334.8} = .45$$

Using Sheet ES - 601:

$$\frac{Q_O}{Q_I} = .4 \text{ where } Q_I = 3595 \text{ cfs}$$

$$Q_O = 3595 \times .4 = 1438 \text{ cfs}$$

Assuming a broad crested weir:

$$Q = 3.09 \ (H)^{3/2} \ W$$

$$W = \frac{Q}{3.09(H)^{3/2}} = \frac{1438}{3.09(5)^{1/5}} = 41.6 \text{ ft. Use 45 feet.}$$

Spillway width selected = 45 feet bottom width.

SPRING LAKE

CRITICAL ELEVATIONS* AND DIMENSIONS

Elevation of Normal Pool	521 ft.
Elevation of Emergency Spillway Crest	525 ft.
Elevation of Top of Dam	531 ft.
Spillway Width	45 ft.
Dam Top Width with 3:1 Side Slopes	30 ft.
Elevation of Bottom	508 ft.

*Elevations are from mean sea level.

ENGINEERING REPORT

Table of Contents

DATE	ADMENDMENT/ADDITION
9/5/74	Original report compiled.
12/12/74	Added Design Summary - Spring Lake and Additional Correspondence.
3/6/75	Addition I to Section II - Spring Lake Spillway Bottom Width Changed to 45 feet.

CANDLEWOOD LAKES PROPERTY

OWNERS ASSOC.,INC.

P.O. BOX 171321
MEMPHIS,TN. 38117

RAM 1/14
~~E170~~
Send copy to George
File

December 31, 1980

RECEIVED
[illegible] 1981
[illegible] OF CONSERVATION
WATER RESOURCES

RECEIVED JAN 2[illegible]

Mr. Robert A. Hunt, Director
Division of Water Resources
Tennessee Department of Conservation
4721 Trousdale Drive
Nashville, Tennessee 37219

Re: Dams at Candlewood Lake, Spring Lake #2, Crystal Lake #4 and
Old Hickory Lake located in Hardeman County

Dear Mr. Hunt:

Your letter of December 1, 1980 to Candlewood Lakes Inc., has been forwarded to us.

As of January 1, 1979, the ownership of the above mentioned dams was transferred to Candlewood Lakes Property Owners Association.

We were not aware of the State Safe Dams Act, but we will be glad to cooperate with you in any way possible to keep the dams safe.

Please direct all future correspondence to Candlewood Lakes Property Owners Association, P.O. Box 171321, Memphis, Tennessee 38117. The phone number is 901-685-6968.

Sincerely,

W J Arnold

W. J. Arnold, President
Candlewood Lakes Property Owners Assn.

WJA/a

PLANS

FOR

SPRING LAKE (LAKE NO. 2)

HARDEMAN COUNTY, TENNESSEE

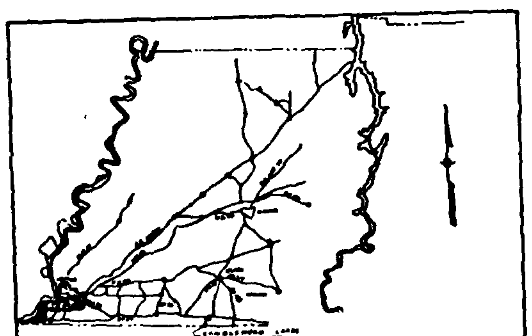
CANDLEWOOD LAKES INCORPORATED

RANDOLPH E. HOLT

DEVELOPER

RABON ENGINEERING COMPANY

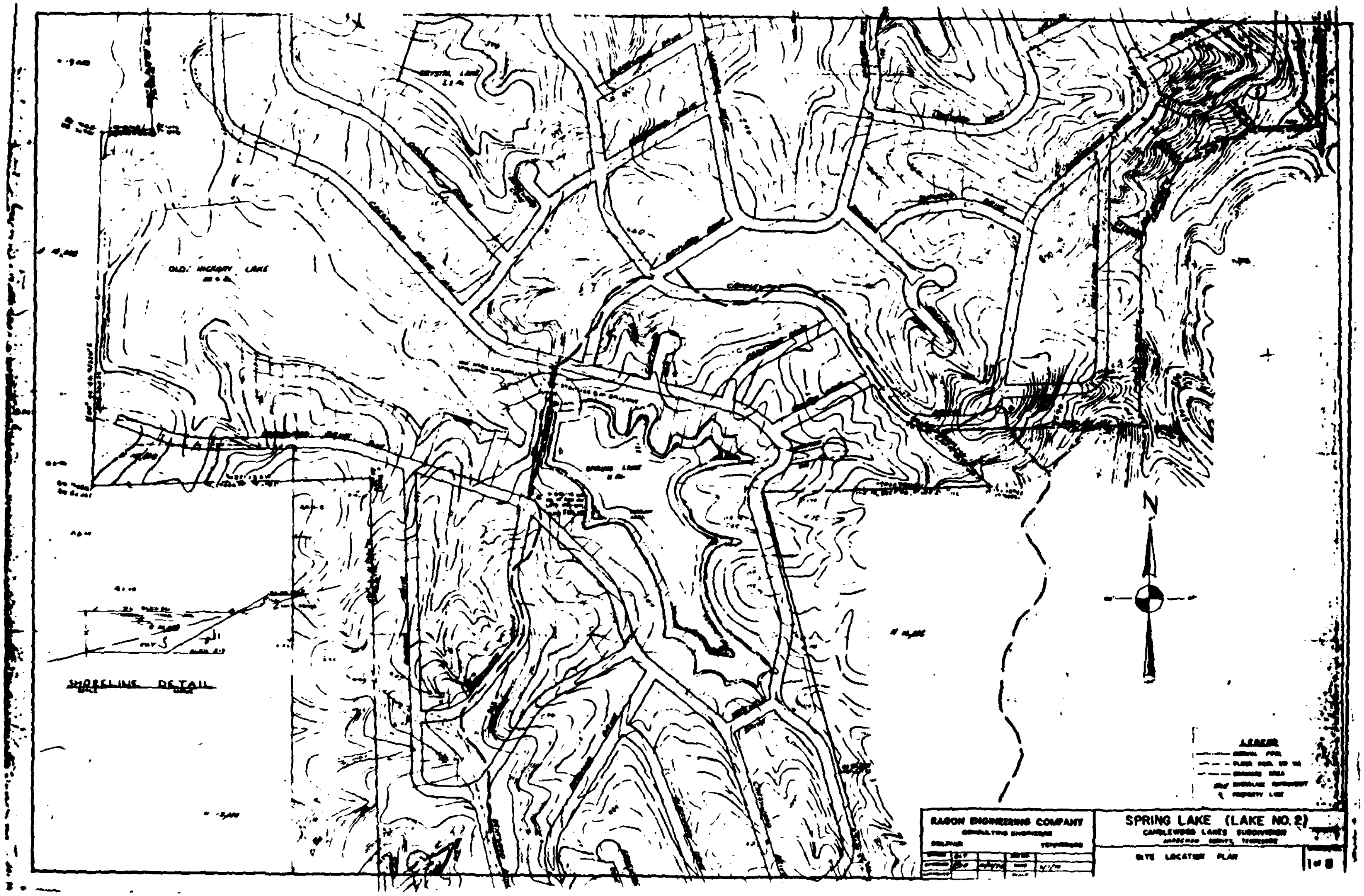
BOLIVAR, TENNESSEE



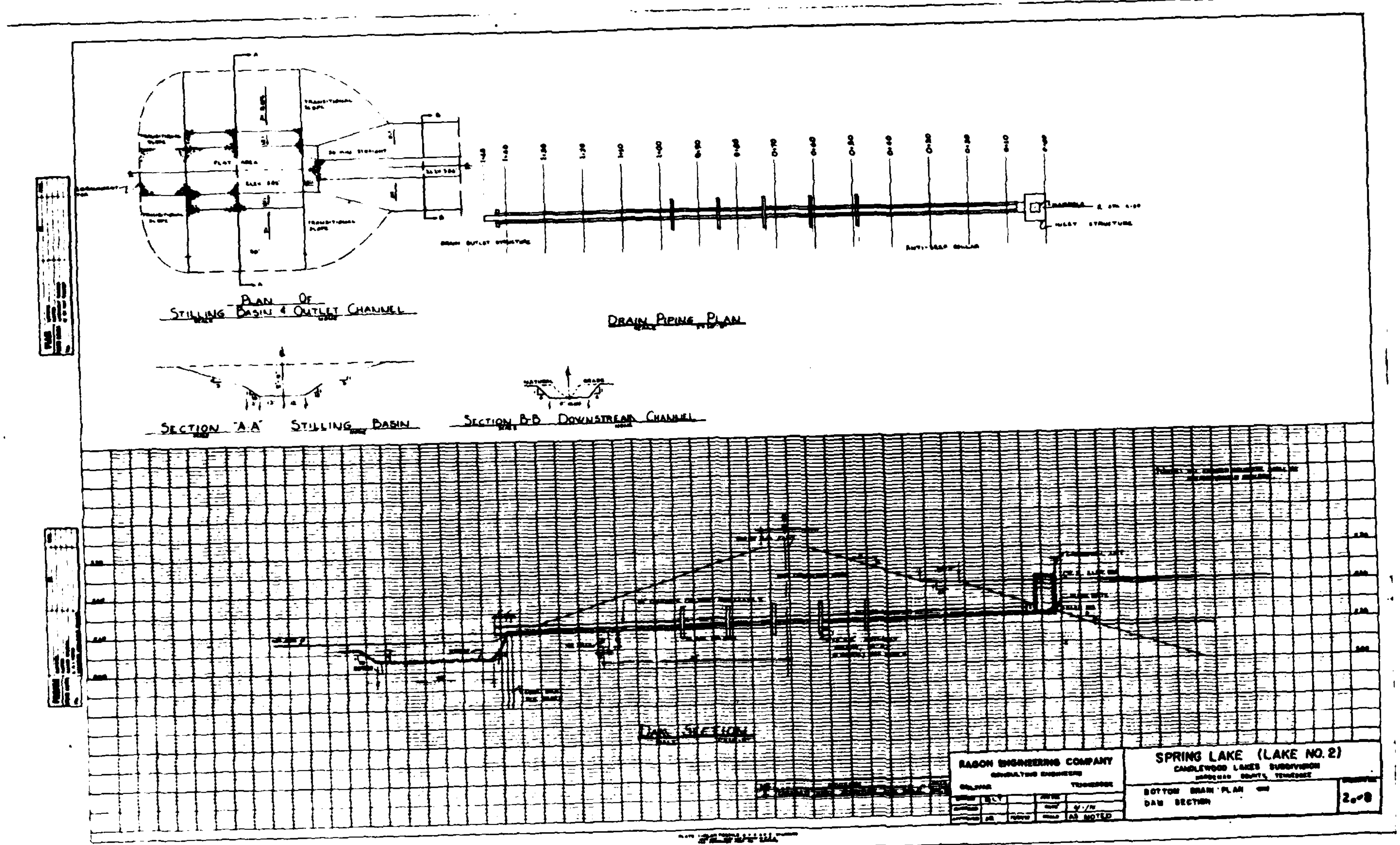
LOCATION MAP

REVISED APRIL 1, 1976

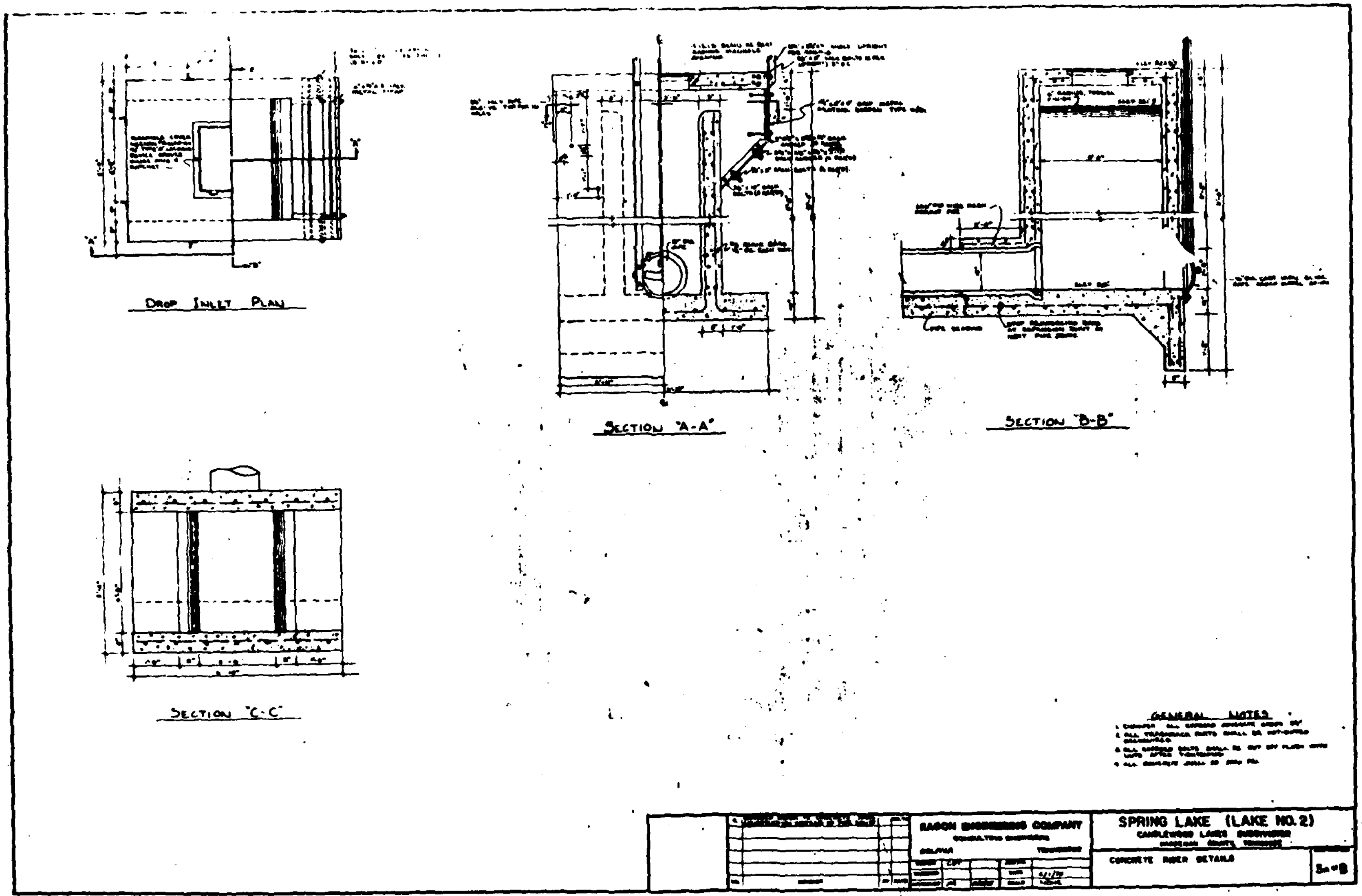
1. [illegible]
2. [illegible]
3. [illegible]

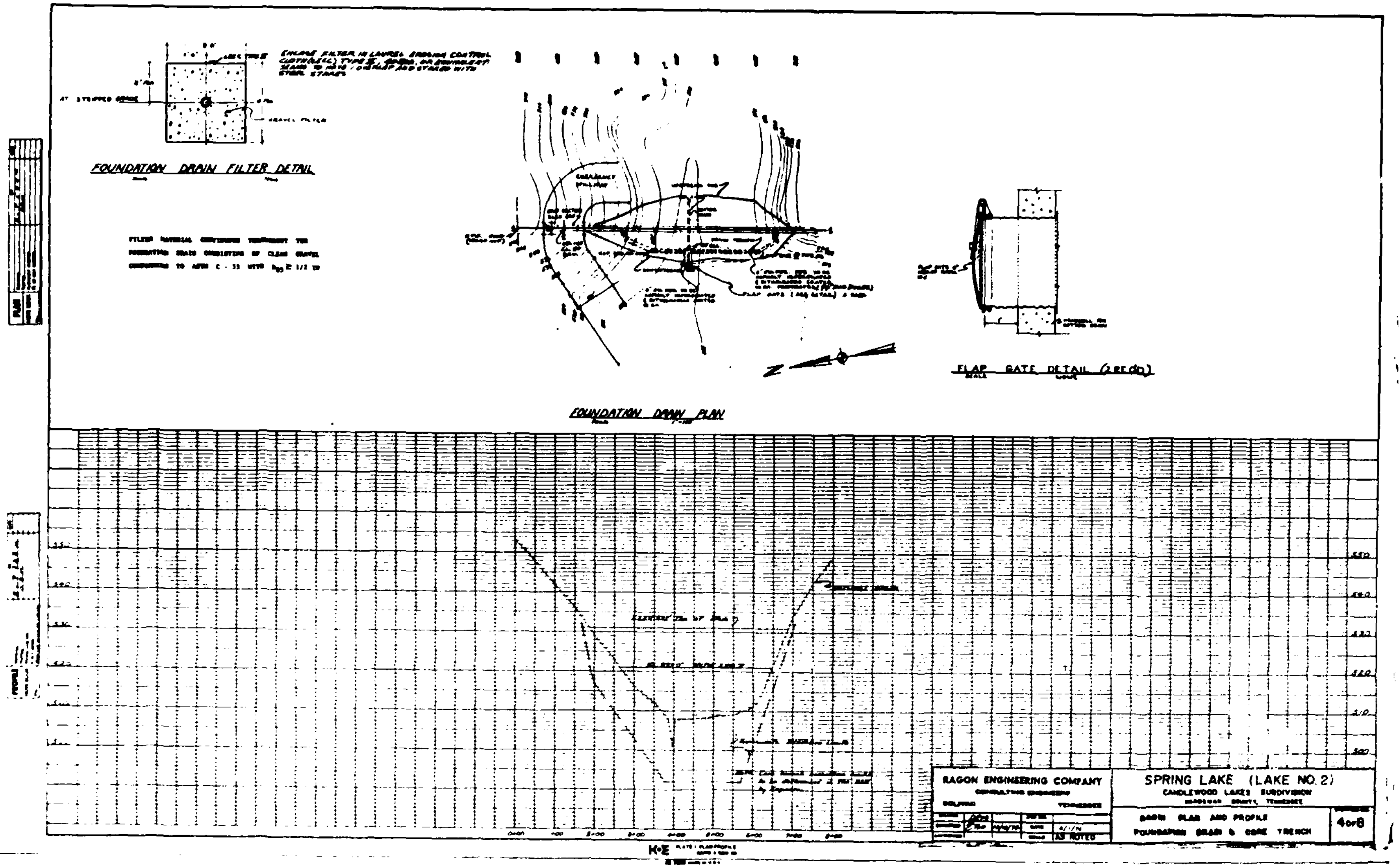


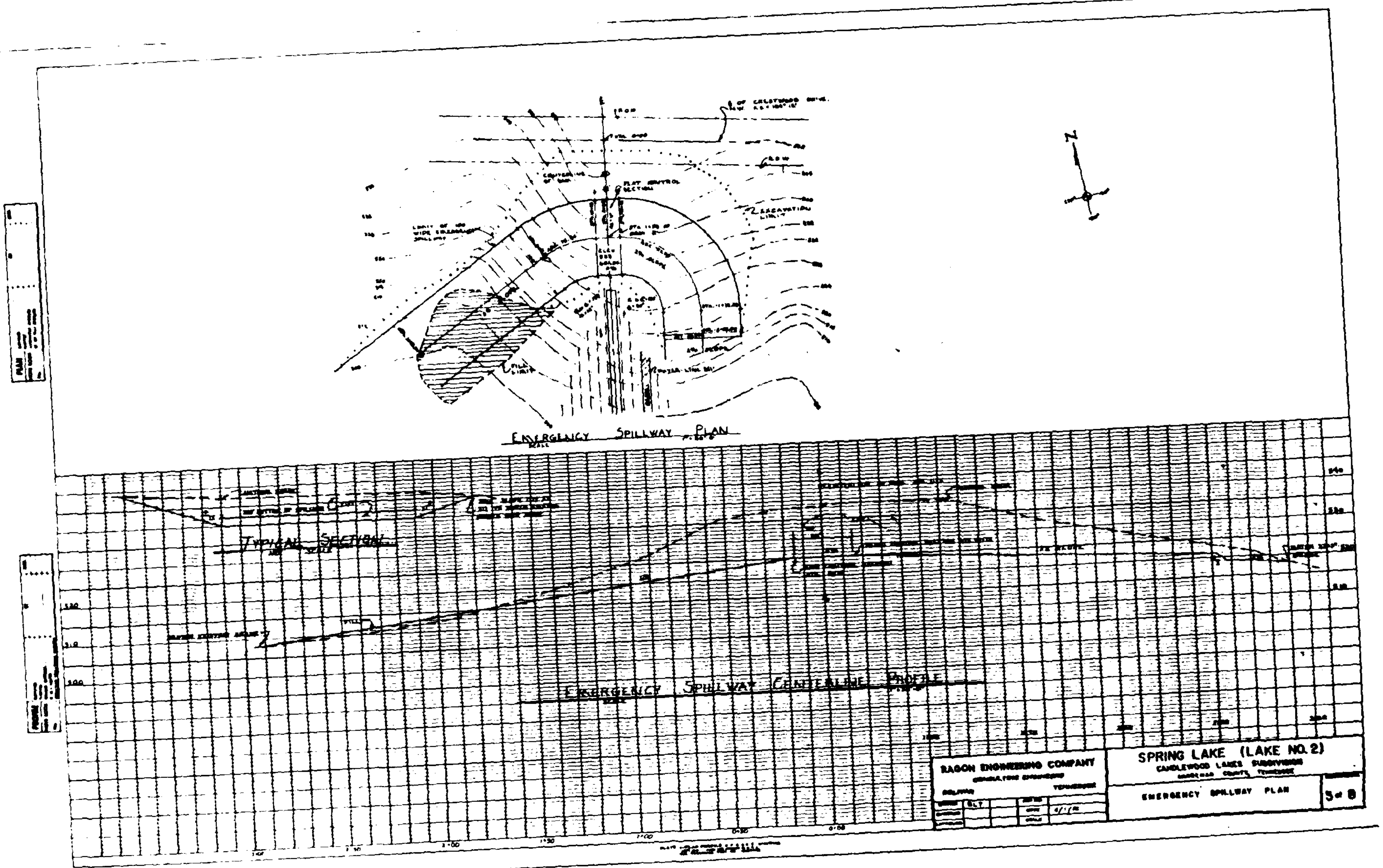
N
SHORELINE DETAIL
OLD HICKORY LAKE
SPRING LAKE
RAGON ENGINEERING COMPANY
SPRING LAKE (LAKE NO. 2)
CANDLEWOOD LAKES SUBDIVISION
SITE LOCATION PLAN



PLAN OF STILLING BASIN & OUTLET CHANNEL
DRAIN PIPING PLAN
SECTION "A-A" STILLING BASIN
SECTION B-B DOWNSTREAM CHANNEL
DAM SECTION
RAGON ENGINEERING COMPANY
CONSULTING ENGINEERS
TENNESSEE
AS NOTED
SPRING LAKE (LAKE NO. 2)
CANDLEWOOD LAKES SUBDIVISION
BOTTOM DRAIN PLAN
DAM SECTION


DROP INLET PLAN
SECTION "A-A"
SECTION "B-B"
SECTION "C-C"
GENERAL NOTES
SPRING LAKE (LAKE NO. 2)
CONCRETE RISER DETAILS


FOUNDATION DRAIN FILTER DETAIL
FOUNDATION DRAIN PLAN
FLAP GATE DETAIL (2 REQ'D)
SPRING LAKE (LAKE NO. 2)
CANDLEWOOD LAKES SUBDIVISION
RAGON ENGINEERING COMPANY
AS NOTED
4 OF 8
FOUNDATION DRAIN & CORE TRENCH



EMERGENCY SPILLWAY PLAN
TYPICAL SECTION
EMERGENCY SPILLWAY CENTERLINE PROFILE
RAGON ENGINEERING COMPANY
SPRING LAKE (LAKE NO. 2)
EMERGENCY SPILLWAY PLAN
5 of 8

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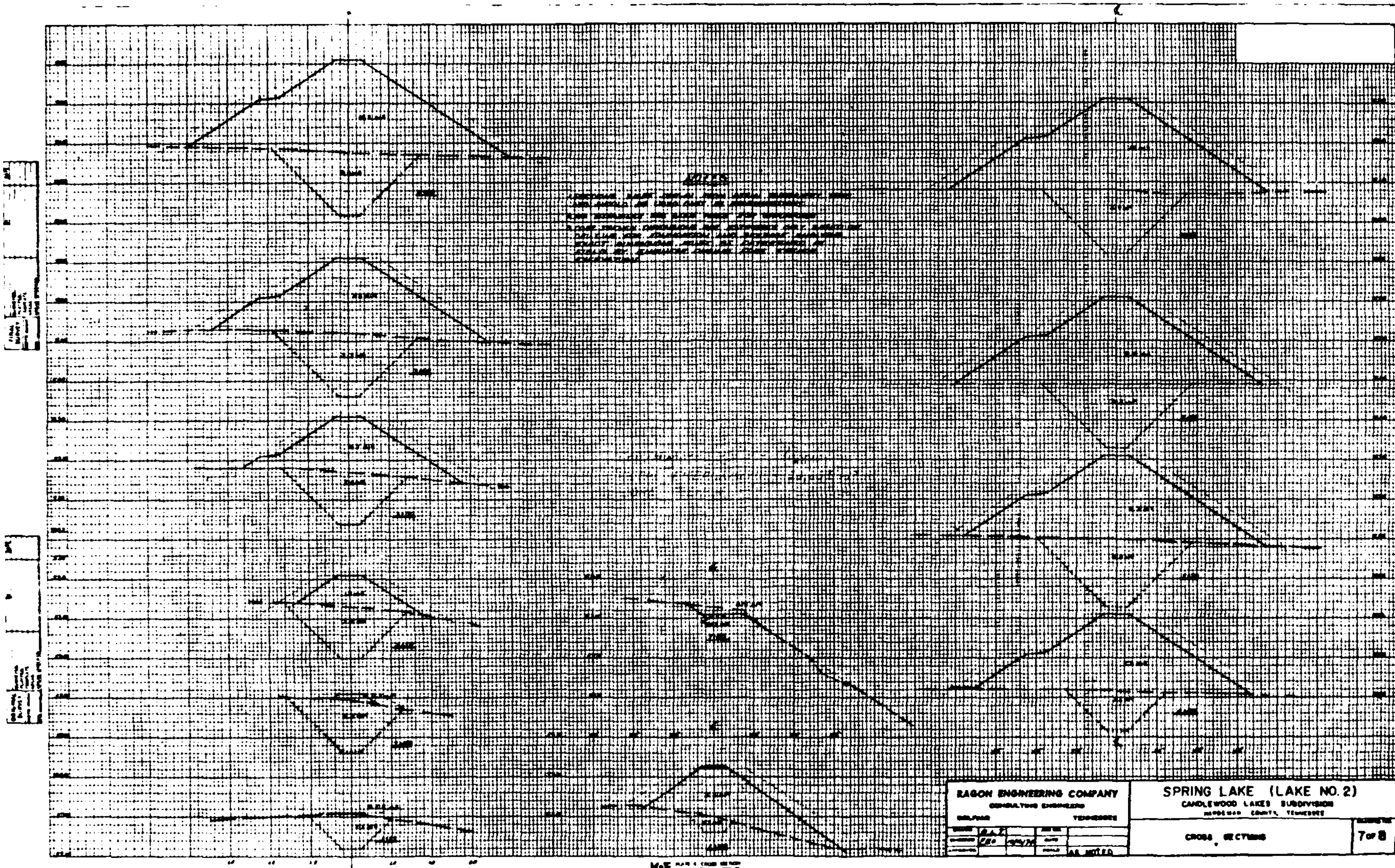
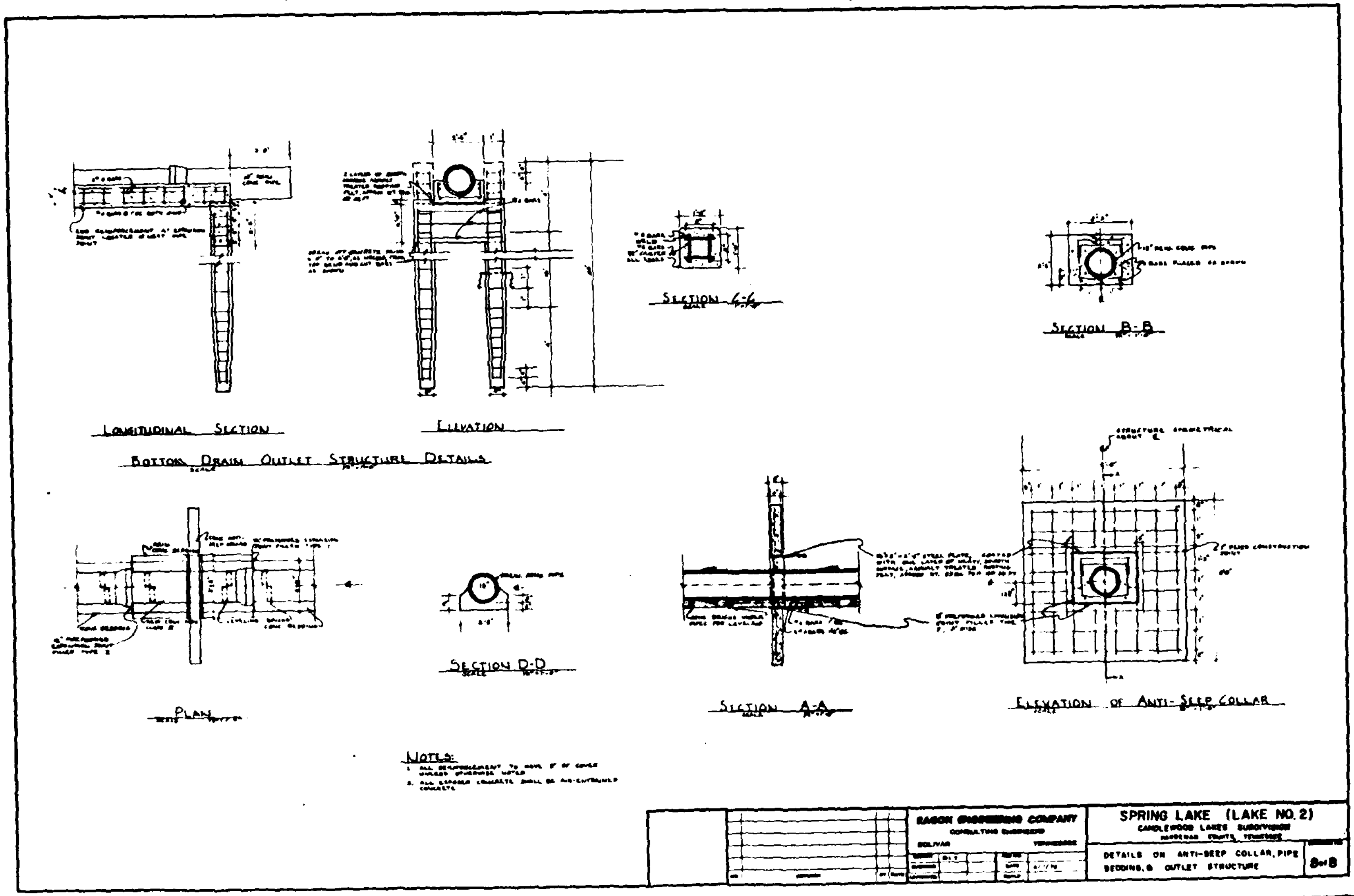

RAGON ENGINEERING COMPANY
SPRING LAKE (LAKE NO. 2)
CANDLEWOOD LAKES SUBDIVISION
CROSS SECTIONS
7 of 8
AS NOTED


LONGITUDINAL SECTION
ELEVATION
BOTTOM DRAIN OUTLET STRUCTURE DETAILS
SECTION C-C
SECTION B-B
PLAN
SECTION D-D
SECTION A-A
ELEVATION OF ANTI-SEEP COLLAR
NOTES:
SPRING LAKE (LAKE NO. 2)
DETAILS ON ANTI-SEEP COLLAR, PIPE BEDDING, & OUTLET STRUCTURE
8 of 8

PLANS

FOR

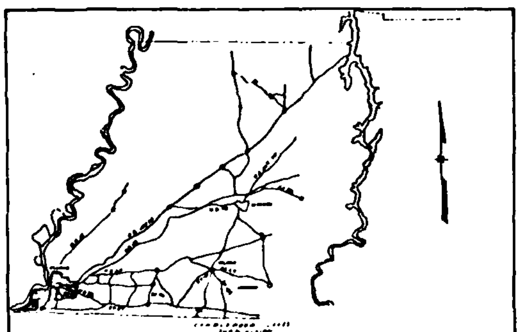
OLD HICKORY LAKE (LAKE NO. 3)

HARDEMAN COUNTY, TENNESSEE

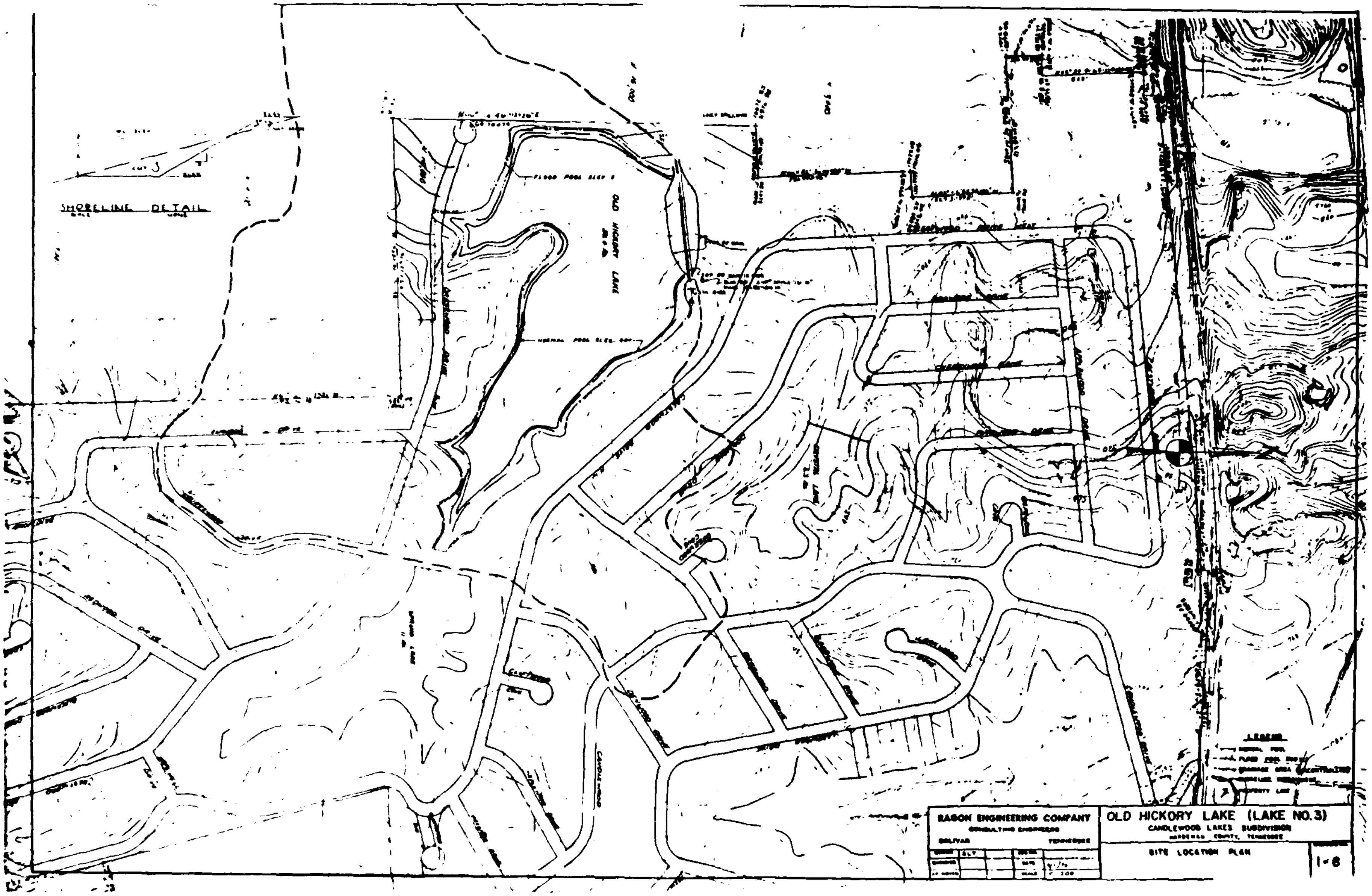
CANDLEWOOD LAKES INCORPORATED

RAGON ENGINEERING COMPANY

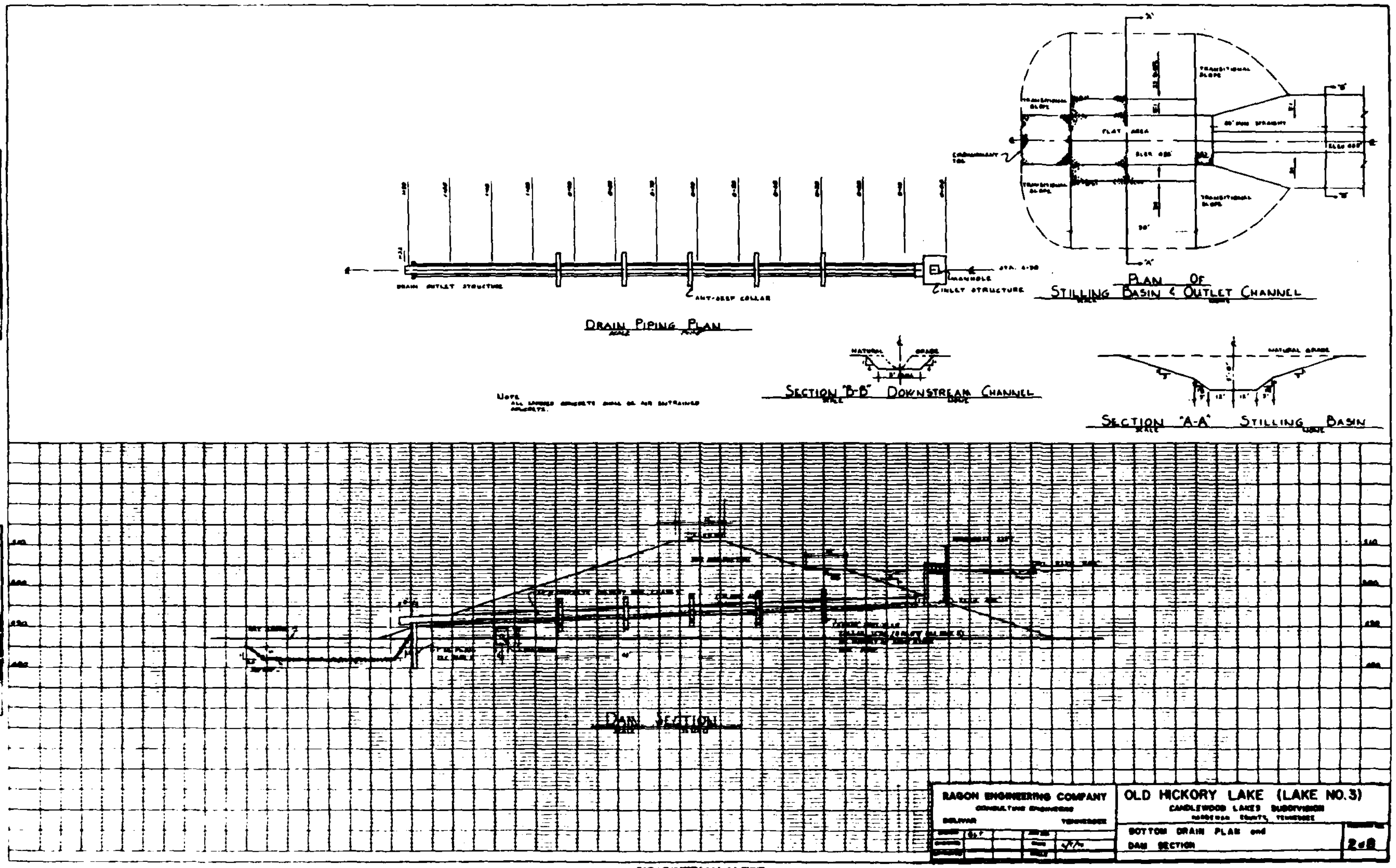
BOLIVAR, TENNESSEE

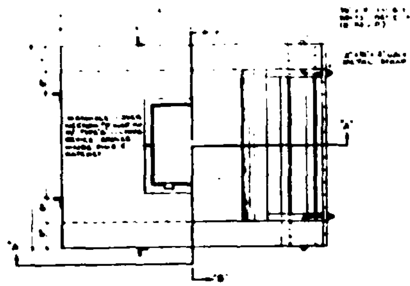


LOCATION MAP

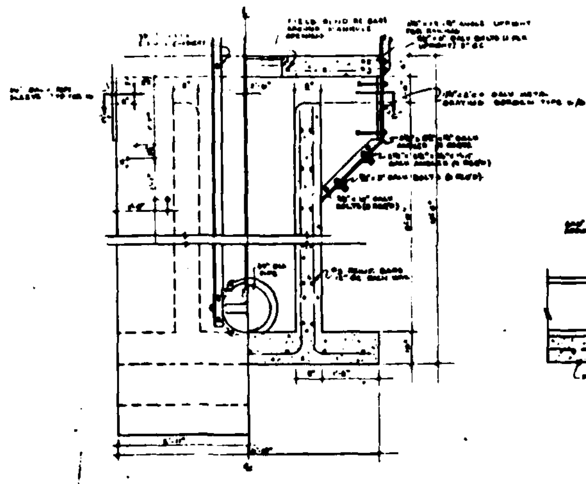


SHORELINE DETAIL
OLD HICKORY LAKE
SPRING LAKE
CRYSTAL LAKE
LEGEND
RAGON ENGINEERING COMPANY
CONSULTING ENGINEERS
BOLIVAR
TENNESSEE
OLD HICKORY LAKE (LAKE NO.3)
CANDLEWOOD LAKES SUBDIVISION
HARDEMAN COUNTY, TENNESSEE
SITE LOCATION PLAN
1-6

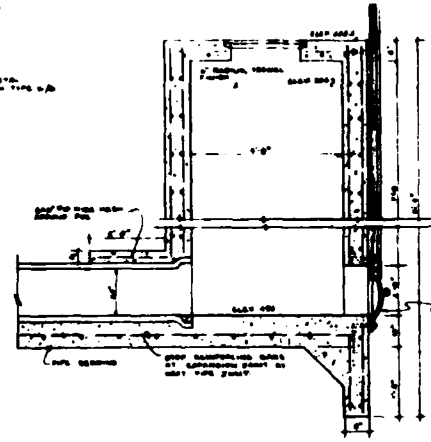

PLAN OF STILLING BASIN & OUTLET CHANNEL
DRAIN PIPING PLAN
SECTION "B-B" DOWNSTREAM CHANNEL
SECTION "A-A" STILLING BASIN
DAM SECTION
RAGON ENGINEERING COMPANY
BOLIVAR TENNESSEE
OLD HICKORY LAKE (LAKE NO. 3)
CANDLEWOOD LAKES SUBDIVISION
BOTTOM DRAIN PLAN and
DAM SECTION
2 of 8



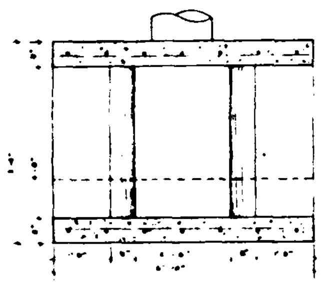
DROP INLET PLAN



SECTION "A-A"



SECTION "B-B"

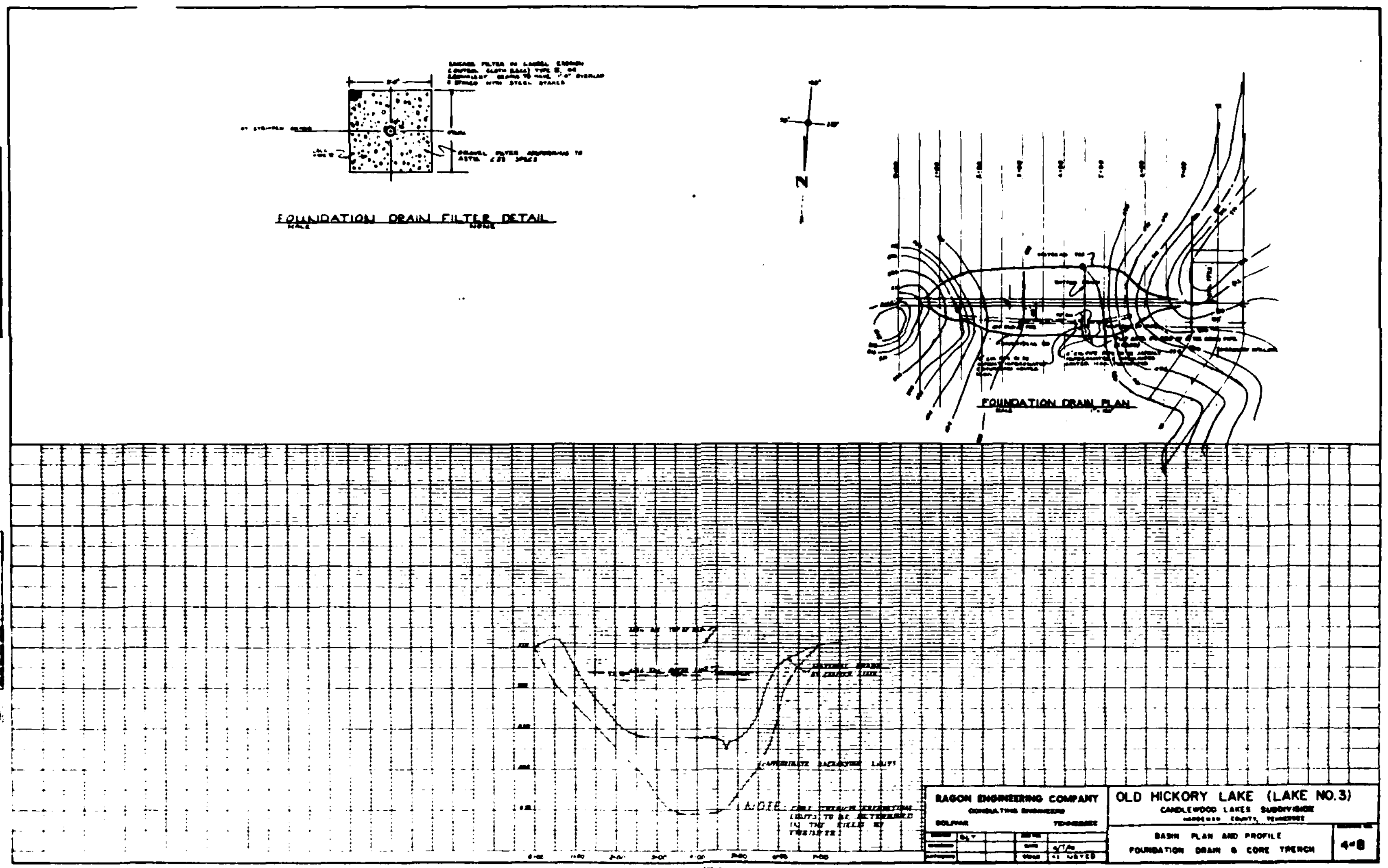


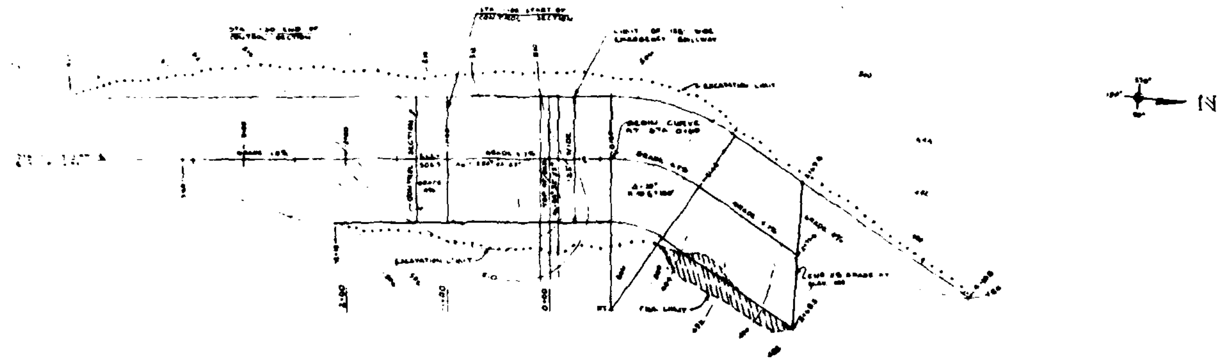
SECTION "C-C"

GENERAL NOTES

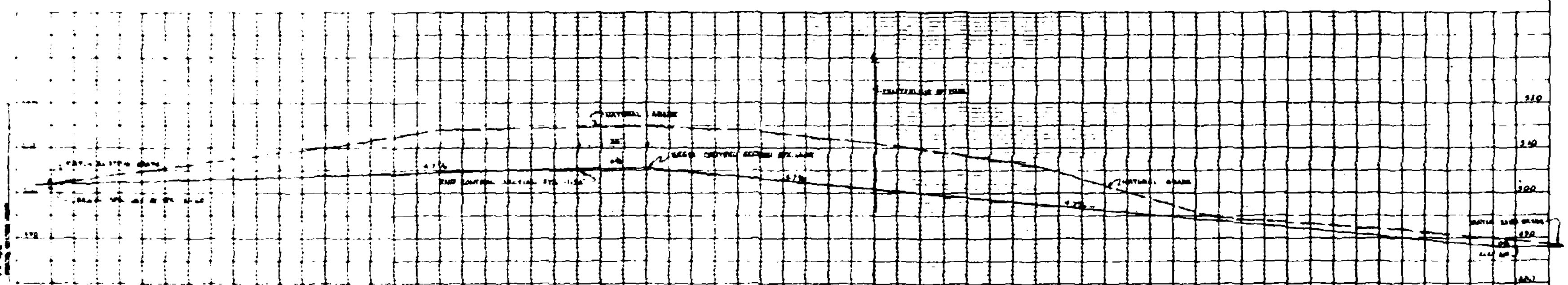
1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]

[illegible] ENGINEERING COMPANY CONSULTING ENGINEERS BOLIVAR TENNESSEE	OLD HICKORY LAKE (LAKE NO.3) CANDLEWOOD LAKES SUBDIVISION [illegible]
	CONCRETE RISER DETAILS
	3 of 8


FOUNDATION DRAIN FILTER DETAIL
FOUNDATION DRAIN PLAN
N
RAGON ENGINEERING COMPANY
CONSULTING ENGINEERS
BOLIVAR TENNESSEE
OLD HICKORY LAKE (LAKE NO.3)
CANDLEWOOD LAKES SUBDIVISION
HARDEMAN COUNTY, TENNESSEE
BASIN PLAN AND PROFILE
FOUNDATION DRAIN & CORE TRENCH
4-8
AS NOTED

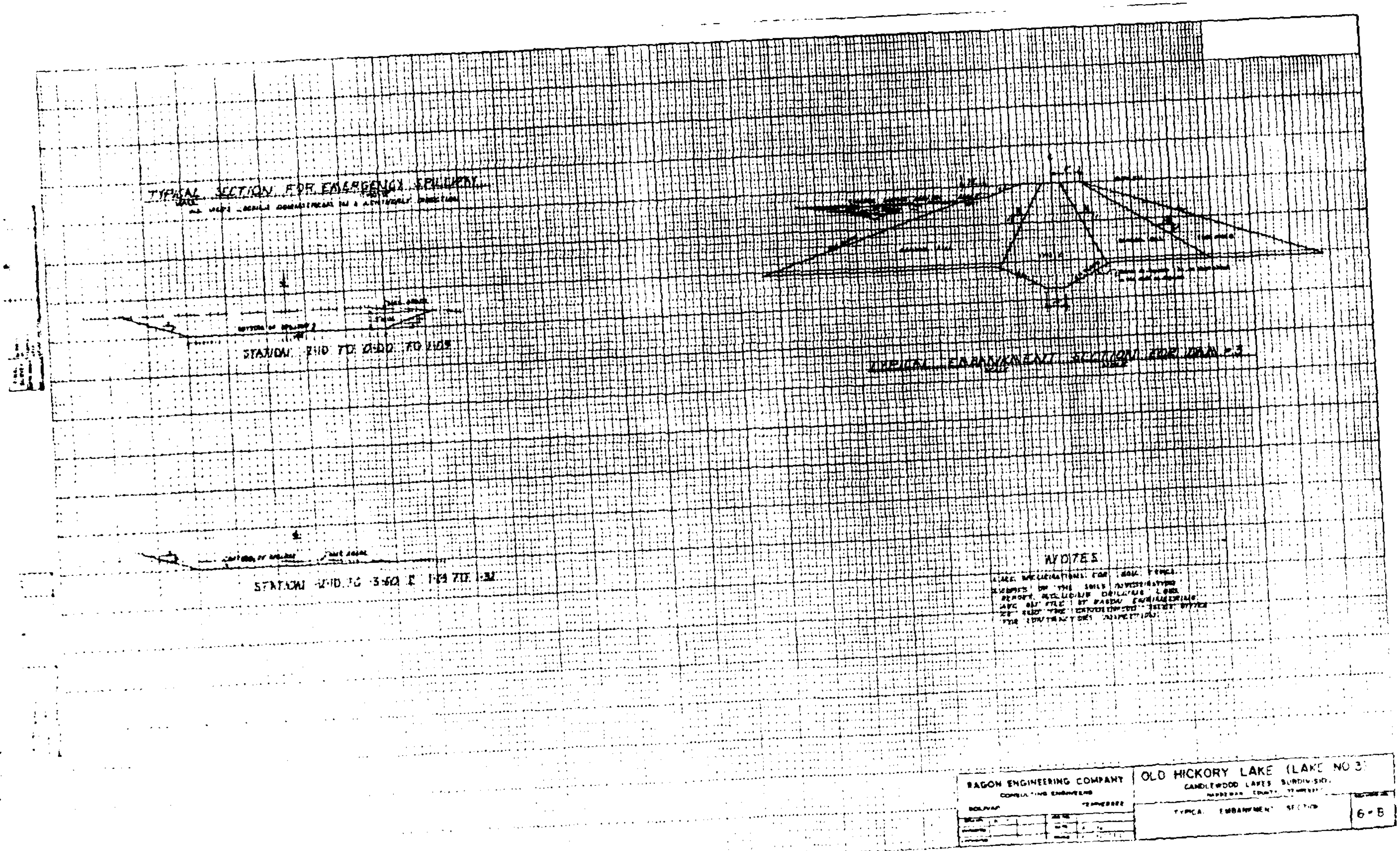


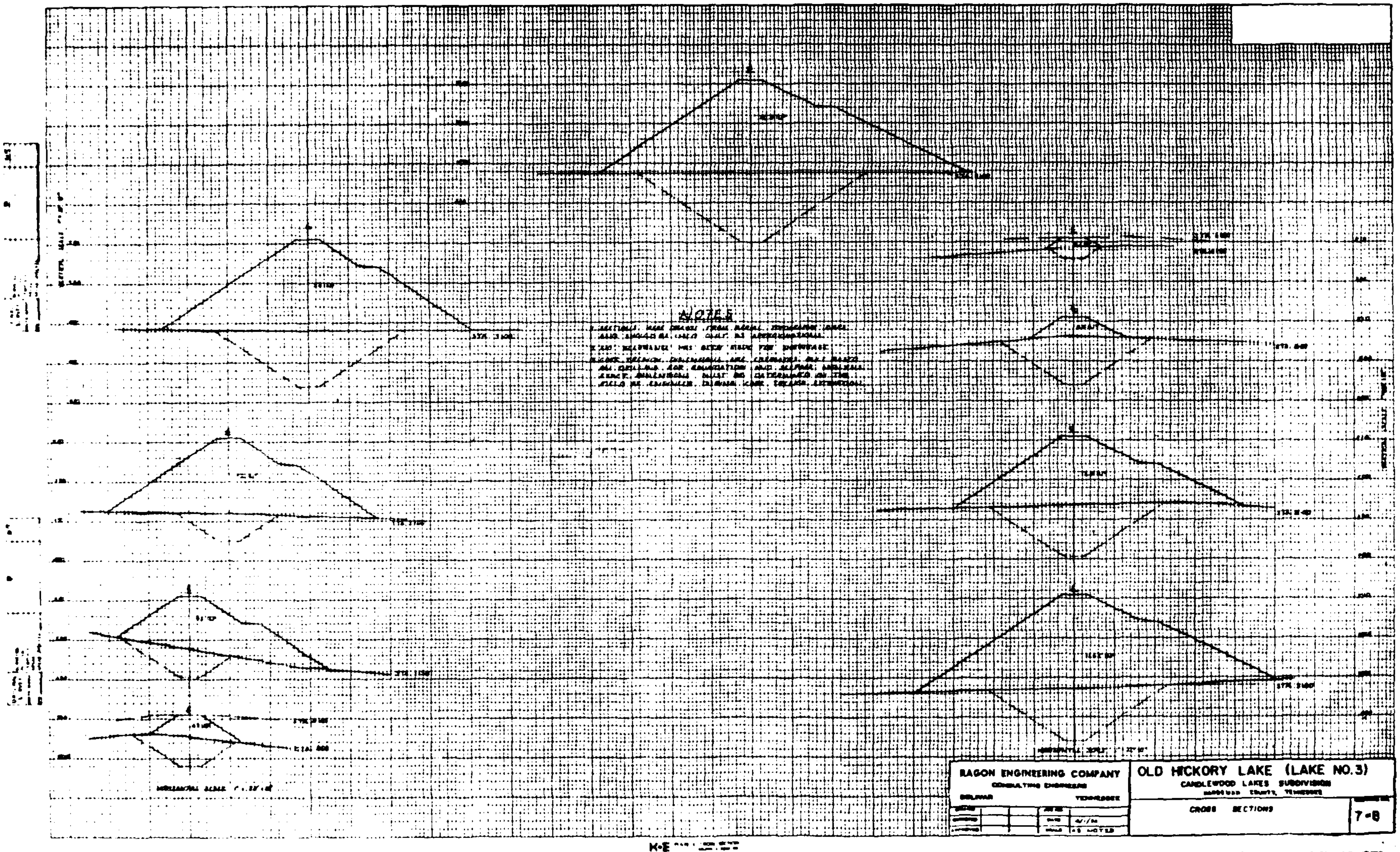
EMERGENCY SPILLWAY PLAN

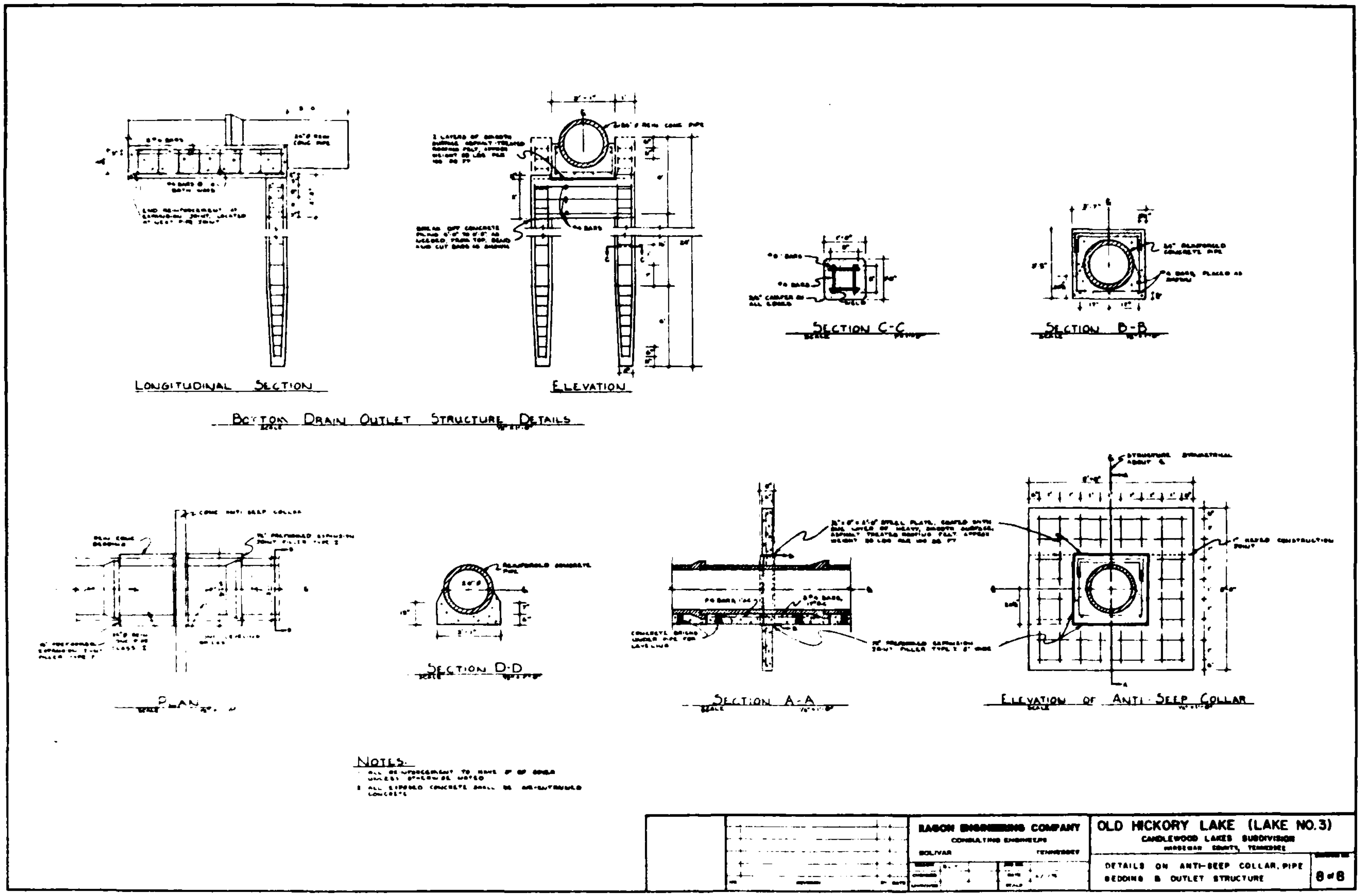


EMERGENCY SPILLWAY CENTERLINE PROFILE

RAGON ENGINEERING COMPANY CONSULTING ENGINEERS BOLIVAR TENNESSEE	OLD HICKORY LAKE (LAKE NO. 3) CANDLEWOOD LAKES SUBDIVISION HARDEMAN COUNTY, TENNESSEE
DRAWN R.T. DATE 6/7/78	EMERGENCY SPILLWAY PLAN — 5 of 8


TYPICAL SECTION FOR EMERGENCY SPILLWAY
STATION 2+10 TO 0+00 TO 1+05
STATION 0+00 TO 3+60 & 1+14 TO 1+32
TYPICAL EMBANKMENT SECTION FOR DAM # 3
NOTES
RAGON ENGINEERING COMPANY
OLD HICKORY LAKE (LAKE NO 3)
CANDLEWOOD LAKES SUBDIVISION
TYPICAL EMBANKMENT SECTION
6-B


NOTES
RAGON ENGINEERING COMPANY
CONSULTING ENGINEERS
BOLIVAR TENNESSEE
OLD HICKORY LAKE (LAKE NO. 3)
CANDLEWOOD LAKES SUBDIVISION
CROSS SECTIONS
7-B



LONGITUDINAL SECTION
ELEVATION
BOTTOM DRAIN OUTLET STRUCTURE DETAILS
SECTION C-C
SECTION B-B
PLAN
SECTION D-D
SECTION A-A
ELEVATION OF ANTI-SEEP COLLAR
NOTES:
EASON ENGINEERING COMPANY
CONSULTING ENGINEERS
BOLIVAR
TENNESSEE
OLD HICKORY LAKE (LAKE NO.3)
CANDLEWOOD LAKES SUBDIVISION
HARDEMAN COUNTY, TENNESSEE
DETAILS ON ANTI-SEEP COLLAR, PIPE BEDDING & OUTLET STRUCTURE
8 of 8

RAGON ENGINEERING COMPANY
CONSULTING ENGINEERS
725 WEST MARKET ST.
P. O. Box 367
BOLIVAR, TENNESSEE 38008

JAMES H. RAGON, P. E.

DON R. MOORE, BSCE; EIT
EDMOND B. O'NEILL, BSME
BOBBY L. TULLEY, BSAET

December 7, 1976

Mr. Robert A. Hunt
Tennessee Department of Conservation
Division of Water Resources
6213 Charlotte Ave.
Nashville, Tennessee 37209

Re: Candlewood Subdivision
Old Hickory Lake (Lake #3)

Dear Mr. Hunt:

The construction of Old Hickory Lake (Lake #3) has been completed, except for some shoreline work. The completed construction was done in substantial conformity with the approved plans and specifications as prepared by Ragon Engineering Company.

Yours truly,

James H. Ragon

James H. Ragon, P. E.

JHR/ct

Enc.

cc: Mr. Edmond B. O'Neill
Regional Engineer

S & W Construction Company
Memphis, Tennessee

CML

ANALYSES OF MOISTURE DENSITY TEST OF COMPACTED FILL

Contractor S & W Construction Company

Project CANDLEWOOD LAKES PROJECT OLD HICKORY DAM

Report to S & W Construction Company (2)

Date April 16, 1976

Lab. No. 30124

Test No.	1	2	3	4		
Density of Sand (lbs./cu. ft.)	98.0	98.0	98.0	98.0		
Wgt. of Jar & Sand (before test)	7.70	7.59	7.67	7.71		
Wgt. of Jar & Sand (after test)	4.04	3.95	3.98	4.27		
Wgt. of Sand in Hole & Funnel	3.66	3.64	3.69	3.44		
Wgt. of Sand in Funnel	1.68	1.68	1.68	1.68		
Wgt. of Sand in Hole	1.98	1.96	2.01	1.76		
Volume of Hole (cu. ft.)	.0202	.0200	.0205	.01796		
Wgt. of Wet Soil	2.74	2.83	2.74	2.56		
Wgt. of Dry Soil	2.36	2.47	2.38	2.20		
Wgt. of Water	.38	.36	.36	.36		
Moisture Content (% of Dry Wgt.)	16.1	14.6	15.1	16.4		
Density, Dry Soil (lbs./cu. ft.)	116.8	123.5	116.1	122.5		
% Required Density	101.9	107.8	101.3	106.9		
Required Density (lbs./cu. ft.)	114.6	114.6	114.6	114.6		
Optimum Moisture (% of Dry Wgt.)	11.5	11.5	11.5	11.5		
Stone, % by Wgt.						

Location of Tests

1 In Center of Dam 160' W.--About 3' of Fill
2 In center of Dam 260' W.--About 3' of Fill
3 300' W. and 30' N. of Center of Dam--About 3' of Fill
4 In Center of Dam 440' W.--About 3' of Fill

CONS[illegible], INC.
JACK[illegible]ESSEE 38301
[illegible]23-2062

40 OLD HICKORY COVE JACKSON, TENNESSEE 38301
(901) 668-7274

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ANALYSES OF MOISTURE DENSITY TEST OF COMPACTED FILL

Contractor S & W Construction Co.

Project CANDLEWOOD LAKES PROJECT OLD HICKORY DAM

Report to S & W Construction Co. (2)

Date April 20, 1976

Lab. No. 30164

Test No.	1	2	3	4		
Density of Sand (lbs./cu. ft.)	98.0	98.0	98.0	98.0		
Wgt. of Jar & Sand (before test)	7.69	7.58	7.70	7.79		
Wgt. of Jar & Sand (after test)	3.50	3.53	3.50	3.80		
Wgt. of Sand in Hole & Funnel	4.19	4.05	4.20	3.99		
Wgt. of Sand in Funnel	1.98	1.98	1.98	1.98		
Wgt. of Sand in Hole	2.21	2.07	2.22	2.01		
Volume of Hole (cu. ft.)	.0226	.0211	.0227	.0205		
Wgt. of Wet Soil	2.90	2.76	2.85	2.79		
Wgt. of Dry Soil	2.54	2.34	2.40	2.38		
Wgt. of Water	.36	.42	.45	.41		
Moisture Content (% of Dry Wgt.)	14.2	17.9	18.8	17.2		
Density, Dry Soil (lbs./cu. ft.)	112.4	110.9	105.7	116.1		
% Required Density	98.1	96.8	92.2	101.3		
Required Density (lbs./cu. ft.)	114.6	114.6	114.6	114.6		
Optimum Moisture (% of Dry Wgt.)	11.5	11.5	11.5	11.5		
Stone, % by Wgt.						

Location of Tests

1 220' W. and 40' S. from Center of Dam--About 6' of Fill
2 250' W. and 40' N. from Center of Dam--6' of Fill
3 350' W., In Center of Dam--About 7' of Fill
4 450' W.and 55' N. from Center of Dam--6' of Fill

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ANALYSES OF MOISTURE DENSITY TEST OF COMPACTED FILL

Contractor S & W Construction Company

Project CANDLEWOOD LAKES PROJECT OLD HICKORY DAM

Report to S & W Construction (2); Ragon Engineering

Date May 2, 1976

Lab. No. 30284

Test No.	1	2	3	4		
Density of Sand (lbs./cu. ft.)	98.0	98.0	98.0	98.0		
Wgt. of Jar & Sand (before test)	7.86	7.83	7.87	7.86		
Wgt. of Jar & Sand (after test)	3.96	4.07	4.01	3.82		
Wgt. o Sand in Hole & Funnel	3.90	3.76	3.86	4.04		
Wgt. of Sand in Funnel	1.98	1.98	1.98	1.98		
Wgt. of Sand in Hole	1.92	1.78	1.88	2.06		
Volume of Hole (cu. ft.)	.0196	.0182	.0192	.0210		
Wgt. of Wet Soil	2.43	2.26	2.89	3.03		
Wgt. of Dry Soil	1.93	1.82	2.59	2.72		
Wgt. of Water	.50	.44	.30	.31		
Moisture Content (% of Dry Wgt.)	25.9	24.2	11.6	11.4		
Density, Dry Soil (lbs./cu. ft.)	98.5	100.0	134.9	129.5		
% Required Density	86.0	87.3	112.0	107.5		
Required Density (lbs./cu. ft.)	114.6	114.6	120.5	120.5		
Optimum Moisture (% of Dry Wgt.)	11.5	11.5	11.2	11.2		
Stone, % by Wgt.						

Location of Tests

1 4+10 W in center of Dam--17' of fill
2 3+00 W, 25' S. of Center of Dam--18' of fill
3 2+10 W, 35' N. of Center of Dam--15' of fill
4 1+00 W, 25' S. of Center of Dam--18' of fill

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ANALYSES OF MOISTURE DENSITY TEST OF COMPACTED FILL

Contractor S & W Construction Co. Project CANDLEWOOD LAKES - OLD HICKORY DAM

Report to S & W Construction(2); Ragon Engineering Date July 6, 1976

Lab. No. 30871

Test No.	1	2	3	4		
Density of Sand (lbs./cu. ft.)	98.0	98.0	98.0	98.0		
Wgt. of Jar & Sand (before test)	7.84	7.80	7.92	7.82		
Wgt. of Jar & Sand (after test)	4.04	4.03	4.23	4.26		
Wgt. of Sand in Hole & Funnel	3.80	3.77	3.69	3.56		
Wgt. of Sand in Funnel	1.83	1.83	1.83	1.83		
Wgt. of Sand in Hole	1.97	1.94	1.86	1.73		
Volume of Hole (cu. ft.)	.0201	.01979	.01897	.01765		
Wgt. of Wet Soil	2.53	2.68	2.54	2.34		
Wgt. of Dry Soil	2.06	2.31	2.12	2.04		
Wgt. of Water	.47	.37	.42	.30		
Moisture Content (% of Dry Wgt.)	22.8	16.01	19.8	14.7		
Density, Dry Soil (lbs./cu. ft.)	102.5	116.7	111.8	115.6		
% Required Density	89.4	101.8	97.5	100.9		
Required Density (lbs./cu. ft.)	114.6	114.6	114.6	114.6		
Optimum Moisture (% of Dry Wgt.)	11.5	11.5	11.5	11.5		
Stone, % by Wgt.						

Location of Tests

1 At Sta. 2+00 18' S. off Center of Dam--6' Below Grade
2 At Sta. 2+00 15' N. off Center of Dam--8' Below Grade
3 At Sta. 2+90 In Center of Dam--6' Below Grade
4 At Sta. 3+50 34' N. off Center of Dam-9' Below Grade

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CONSTRUC... S LAB, INC.
41 ...
JACKS... 38301
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ANALYSES OF MOISTURE DENSITY TEST OF COMPACTED FILL

Contractor S & W Construction Co.

Project [illegible] LAKES - OLD HICKORY DAM

Report to S & W Construction(2); Pagon Engineering

Date [illegible], 1976

Lab. No. [illegible]71

Test No.	1	2	3	4		
Density of Sand (lbs./cu. ft.)		[illegible]	[illegible]	[illegible]		
Wgt. of Jar & Sand (before test)	[illegible]	[illegible]	7.92	[illegible]		
Wgt. of Jar & Sand (after test)	[illegible]	[illegible]	[illegible]	[illegible]		
Wgt. of Sand in Hole & Funnel	[illegible]	3.77	3.69	3.56		
Wgt. of Sand in Funnel	[illegible]	[illegible]	[illegible]	[illegible]		
Wgt. of Sand in Hole	[illegible]	[illegible]	[illegible]	[illegible]		
Volume of Hole (cu. ft.)	[illegible]	[illegible]	[illegible]	[illegible]		
Wgt. of Wet Soil	[illegible]	[illegible]	[illegible]	[illegible]		
Wgt. of Dry Soil	[illegible]	2.31	[illegible]	[illegible]		
Wgt. of Water	.47	.37	.42	[illegible]		
Moisture Content (% of Dry Wgt.)	[illegible]	16.01	19.8	14.7		
Density, Dry Soil (lbs./cu. ft.)	[illegible]	[illegible]	111.8	[illegible]		
% Required Density	[illegible]	[illegible]	[illegible]	[illegible]		
Required Density (lbs./cu. ft.)	[illegible]	[illegible]	114.6	[illegible]		
Optimum Moisture (% of Dry Wgt.)	[illegible]	11.5	11.5	11.5		
Stone, % by Wgt.						

Location of Tests

1 At Sta. [illegible] off Center of Dam--6' Below Grade
2 At Sta. [illegible] off Center of Dam--[illegible] Below Grade
3 At Sta. [illegible] in Center of Dam--6' Below Grade
4 At Sta. [illegible] 34' [illegible] off Center of Dam--9' Below Grade

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ANALYSES OF MOISTURE DENSITY TEST OF COMPACTED FILL

Contractor S & W Construction Co[illegible] Project [illegible](OLD HICKORY DAM)

Report to S & W Construction; [illegible] on [illegible]ngineering Date [illegible] 1976

Lab. No. [illegible]

Test No.	[illegible]	[illegible]	[illegible]	[illegible]		
Density of Sand (lbs./cu. ft.)	[illegible]	[illegible]	[illegible]	[illegible]		
Wgt. of Jar & Sand (before test)		[illegible]	[illegible]	[illegible]		
Wgt. of Jar & Sand (after test)	[illegible]	4.[illegible]	4.07	[illegible]		
Wgt. of Sand in Hole & Funnel	[illegible].[illegible]7	[illegible]	[illegible]	[illegible]		
Wgt. of Sand in Funnel	[illegible]	[illegible]	[illegible]	[illegible]		
Wgt. of Sand in Hole	[illegible]	[illegible]	[illegible]	[illegible]		
Volume of Hole (cu. ft.)	[illegible]	[illegible]	[illegible]	[illegible]		
Wgt. of Wet Soil	[illegible]	[illegible]	[illegible]	[illegible]		
Wgt. of Dry Soil	[illegible]	[illegible]	[illegible]	[illegible]		
Wgt. of Water	[illegible]	[illegible]	[illegible]	[illegible]		
Moisture Content (% of Dry Wgt.)	[illegible]	[illegible]	[illegible]	[illegible]		
Density, Dry Soil (lbs./cu. ft.)	[illegible]	[illegible]	[illegible]	[illegible]		
% Required Density	[illegible]	[illegible]	[illegible]	[illegible]		
Required Density (lbs./cu. ft.)	[illegible]	[illegible]	[illegible]	[illegible]		
Optimum Moisture (% of Dry Wgt.)	11.2	11.2	11.2	[illegible]		
Stone, % by Wgt.						

Location of Tests

1 Sta. 2+60 18' S.--6' below grade
2 Sta. 4+50 20' S.--12' below grade
3 Sta. [illegible]+10 25' N.--12' below grade
4 Sta. [illegible] 10' N.--8' below grade

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ANALYSES OF MOISTURE DENSITY TEST OF COMPACTED FILL

Contractor S & W Construction Company

Project [illegible] LAKES(OLD HICKORY DAM)

Report to S & W Construction; Ragon Engineering

Date [illegible], 1976

Lab. No. 30909

Test No.	1	2	3	4		
Density of Sand (lbs./cu. ft.)	[illegible]	98.0	98.0	98.0		
Wgt. of Jar & Sand (before test)	7.94	7.86	7.89	7.87		
Wgt. of Jar & Sand (after test)	3.77	4.05	4.03	4.24		
Wgt. of Sand in Hole & Funnel	4.17	3.81	3.86	3.63		
Wgt. of Sand in Funnel	1.83	1.83	1.83	1.83		
Wgt. of Sand in Hole	2.34	1.98	2.03	1.80		
Volume of Hole (cu. ft.)	.0239	.0202	.0207	.0184		
Wgt. of Wet Soil	3.27	2.75	2.86	2.57		
Wgt. of Dry Soil	2.95	2.45	2.55	2.29		
Wgt. of Water	.32	.30	.31	.28		
Moisture Content (% of Dry Wgt.)	10.8	12.2	12.2	12.2		
Density, Dry Soil (lbs./cu. ft.)	123.4	121.3	123.2	124.5		
% Required Density	102.4	100.7	102.2	103.3		
Required Density (lbs./cu. ft.)	120.5	120.5	120.5	120.5		
Optimum Moisture (% of Dry Wgt.)	11.2	11.2	11.2	11.2		
Stone, % by Wgt.						

Location of Tests

1 Sta. 2+00 18' S.--6' Below Grade
2 Sta. 4+50 20' S.--12' Below Grade
3 Sta. 5+10 25' N.--12' Below Grade
4 Sta. 6+00 10' N.--8' Below Grade

CONSTRUCT[illegible] INC.
JACKS[illegible]

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ANALYSES OF MOISTURE DENSITY TEST OF COMPACTED FILL

Contractor S & W Construction Co. Project CA[illegible] LAKES - OLD HICKORY DAM

Report to S & W Construction(2); Ragon Engineering Date [illegible] 12, 1976

Lab. No. 30947

Test No.	1	2	3	4		
Density of Sand (lbs./cu. ft.)	[illegible]	98.0	98.0	98.0		
Wgt. of Jar & Sand (before test)	[illegible]	7.99	7.87	7.92		
Wgt. of Jar & Sand (after test)	3.85	4.15	4.13	4.13		
Wgt. of Sand in Hole & Funnel	3.98	3.84	3.74	3.79		
Wgt. of Sand in Funnel	[illegible]	1.83	1.83	1.85		
Wgt. of Sand in Hole	[illegible]	2.01	[illegible]	[illegible]		
Volume of Hole (cu. ft.)	[illegible]	.0205	[illegible]	[illegible]		
Wgt. of Wet Soil	2.72	2.57	2.49	2.44		
Wgt. of Dry Soil	2.42	2.29	2.23	2.14		
Wgt. of Water	.30	.28	.26	.30		
Moisture Content (% of Dry Wgt.)	12.4	12.2	11.7	14.0		
Density, Dry Soil (lbs./cu. ft.)	110.5	111.7	114.4	107.[illegible]		
% Required Density	96.4	97.[illegible]	99.4	[illegible]		
Required Density (lbs./cu. ft.)	114.6	114.6	115.1	[illegible]		
Optimum Moisture (% of Dry Wgt.)	11.5	11.5	14.6	11.[illegible]		
Stone, % by Wgt.						

Location of Tests

1 At Sta. 5+30 5' S. off Center of Dam--[illegible]' Below Grade
2 At Sta. 4 20 5[illegible]' S. [illegible]
3 At Sta. 4+30 25' S. off Center of Dam--9' Below Grade
4 At Sta. 5+40 In Center of Dam--9' Below Grade

NEW ADDRESS
CONSTRUCTION [illegible] S LAB, INC.
41 [illegible]
JACKSON, [illegible] 38301
[illegible] 423-2052

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ANALYSES OF MOISTURE DENSITY TEST OF COMPACTED FILL

Contractor S & W Construction Co. Project CANDLEWOOD LAKES - OLD HICKORY DAM

Report to S & W Construction(2); Ragon Engineering Date July 12, 1976

Lab. No. 30947

Test No.	1	2	3	4		
Density of Sand (lbs./cu. ft.)	98.0	98.0	98.0	98.0		
Wgt. of Jar & Sand (before test)	7.81	7.99	7.87	7.92		
Wgt. of Jar & Sand (after test)	3.83	4.15	4.13	4.13		
Wgt. of Sand in Hole & Funnel	3.98	3.84	3.74	3.79		
Wgt. of Sand in Funnel	1.83	1.83	1.83	1.83		
Wgt. of Sand in Hole	2.15	2.01	1.91	1.96		
Volume of Hole (cu. ft.)	.0219	.0205	.0195	.0200		
Wgt. of Wet Soil	2.72	2.57	2.49	2.44		
Wgt. of Dry Soil	2.42	2.29	2.23	2.14		
Wgt. of Water	.30	.28	.26	.30		
Moisture Content (% of Dry Wgt.)	12.4	12.2	11.7	14.0		
Density, Dry Soil (lbs./cu. ft.)	110.5	111.7	114.4	107.0		
% Required Density	96.4	97.5	99.4	93.4		
Required Density (lbs./cu. ft.)	114.6	114.6	115.1	114.6		
Optimum Moisture (% of Dry Wgt.)	11.5	11.5	14.6	11.5		
Stone, % by Wgt.						

Location of Tests

1 At Sta. 3+30 5' S. off Center of Dam--8' Below Grade
2 At Sta. 4+20 35' N. off Center of Dam--9' Below Grade
3 At Sta. 4+30 25' S. off Center of Dam--9' Below Grade
4 At Sta. 5+40 In Center of Dam--9' Below Grade

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ANALYSES OF MOISTURE DENSITY TEST OF COMPACTED FILL

Contractor S &W Construction Company Project CANDLEWOOD LAKES - OLD HICKORY DAM

Report to S & W Construction(2); Ragon Engineering Date July 14, 1976

Lab. No. 30984

Test No.	1	2	3	4	5	
Density of Sand (lbs./cu. ft.)	98.0	98.0	98.0	98.0	98.0	
Wgt. of Jar & Sand (before test)	7.78	7.94	7.86	7.75	7.82	
Wgt. of Jar & Sand (after test)	3.83	4.07	4.04	3.70	3.77	
Wgt. of Sand in Hole & Funnel	3.95	3.87	3.82	4.05	4.05	
Wgt. of Sand in Funnel	1.83	1.83	1.83	1.83	1.83	
Wgt. of Sand in Hole	2.12	2.04	1.99	2.22	2.22	
Volume of Hole (cu. ft.)	.0216	.0208	.0203	.0227	.0227	
Wgt. of Wet Soil	2.81	2.85	2.73	3.06	3.18	
Wgt. of Dry Soil	2.50	2.49	2.31	2.69	2.72	
Wgt. of Water	.31	.36	.42	.37	.46	
Moisture Content (% of Dry Wgt.)	12.4	14.5	18.2	13.8	16.9	
Density, Dry Soil (lbs./cu. ft.)	115.7	119.7	113.8	118.5	119.8	
% Required Density	96.0	99.3	98.9	98.9	99.4	
Required Density (lbs./cu. ft.)	120.5	120.5	115.1	120.5	120.5	
Optimum Moisture (% of Dry Wgt.)	11.2	11.2	14.6	11.2	11.2	
Stone, % by Wgt.						

Location of Tests

1 Sta. 1+46 In Center of Dam--5' Below Grade
2 Sta. 2+75 5' S. off Center of Dam--5' Below Grade
3 Sta. 3+98 5' N. off Center of Dam--5' Below Grade
4 Sta. 4+75 15' S. off Center of Dam--5' Below Grade
5 Recheck at Sta. 5+40 in Center of Dam--9' Below Grade

[illegible]
CONST[illegible]
[illegible]
JAC[illegible] 38301
PHONE [illegible]

ANALYSES OF MOISTURE DENSITY TEST OF COMPACTED FILL

Contractor: S &W Construction Company

Project: CANDLEWOOD LAKES - OLD HICKORY DAM

Report to: S & W Construction(2); Ragon Engineering

Date: July [illegible], 1976

Lab. No. 30984

Test No.	1	2	3	4	5	
Density of Sand (lbs./cu. ft.)	[illegible]	98.0	98.0	98.0	98.0	
Wgt. of Jar & Sand (before test)	7.78	7.94	7.86	7.75	7.82	
Wgt. of Jar & Sand (after test)	3.83	4.07	4.04	3.70	3.77	
Wgt. of Sand in Hole & Funnel	3.95	3.87	3.82	4.05	4.05	
Wgt. of Sand in Funnel	1.83	1.83	1.83	1.83	1.83	
Wgt. of Sand in Hole	2.12	2.04	1.99	2.22	2.22	
Volume of Hole (cu. ft.)	.0216	.0208	.0203	.0227	.0227	
Wgt. of Wet Soil	2.81	2.85	2.73	3.06	3.18	
Wgt. of Dry Soil	2.50	2.49	2.31	2.69	2.72	
Wgt. of Water	.31	.36	.42	.37	.46	
Moisture Content (% of Dry Wgt.)	12.4	14.5	18.2	13.8	16.9	
Density, Dry Soil (lbs./cu. ft.)	115.7	119.7	113.8	118.5	119.8	
% Required Density	96.0	99.3	98.9	98.9	99.4	
Required Density (lbs./cu. ft.)	120.5	120.5	115.1	[illegible]	[illegible]	
Optimum Moisture (% of Dry Wgt.)	11.2	11.2	14.6	11.2	11.2	
Stone, % by Wgt.						

Location of Tests

1 Sta. 1+46 In Center of Dam--5' Below Grade
2 Sta. 2+75 [illegible]
3 Sta. 3+98 5' N. off Center of Dam--5' Below Grade
4 Sta. 4+75 15' S. off Center of Dam--5' Below Grade
5 Recheck at Sta. 5+40 in Center of Dam--9' Below Grade

NEW ADDRESS
CONSTRUCTION MATERIALS LAB, INC.
41 [illegible]
JACKSON, TENNESSEE 38301
PHONE 423-2062

ANALYSES OF MOISTURE DENSITY TEST OF COMPACTED FILL

Contractor S & W Construction Company

Project CANDLEWOOD LAKES(OLD HICKORY DAM)

Report to S & W Construction (2); Ragon Engineering

Date July 15, 1976

Lab. No. 30991

Test No.	1	2	3	4		
Density of Sand (lbs./cu. ft.)	98.0	98.0	98.0	98.0		
Wgt. of Jar & Sand (before test)	7.70	7.74	7.85	7.79		
Wgt. of Jar & Sand (after test)	4.00	4.06	4.10	3.98		
Wgt. of Sand in Hole & Funnel	3.70	3.68	3.75	3.81		
Wgt. of Sand in Funnel	1.83	1.83	1.83	1.83		
Wgt. of Sand in Hole	1.87	1.85	1.92	1.98		
Volume of Hole (cu. ft.)	.0191	.0189	.0196	.0202		
Wgt. of Wet Soil	2.43	2.50	2.45	2.70		
Wgt. of Dry Soil	2.08	2.19	2.21	2.31		
Wgt. of Water	.35	.31	.24	.39		
Moisture Content (% of Dry Wgt.)	16.8	14.2	10.9	16.9		
Density, Dry Soil (lbs./cu. ft.)	108.9	115.9	112.8	114.4		
% Required Density	97.2	103.5	98.4	102.1		
Required Density (lbs./cu. ft.)	112.0	112.0	114.6	112.0		
Optimum Moisture (% of Dry Wgt.)	14.6	14.6	11.5	14.6		
Stone, % by Wgt.						

Location of Tests

1. Sta. 1+50, 5' N. off Center of Dam--2' Below Grade
2. Sta. 2+55, 5' S. off Center of Dam--2' Below Grade
3. Sta. 4+50, In center of Dam--2' Below Grade
4. Sta. 5+50, In center of dam--2' Below Grade

NEW ADDRESS
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PHONE 423-2062

SOUTHERN STATES INDUSTRIES

Representing Gorman-Rupp

MEMPHIS, TENN.

NO. LITTLE ROCK, ARK.

PROJ. NO. Old Hickory Lake (No. 3)

LOCATION Candlewood Lakes

DATE 12/19/75

ENGINEER JR

PAGE

Principle Spillway Sizing

Criteria: Lower Lake to Elev. 496 (8') within 3 days

$$Np = 504 - 8 = 496$$

$$V_{Np} = 9.5 \times 10^6 \text{ ft}^3$$

$$V_{496} = 2.1 \times 10^6$$

$$7.4 \times 10^6 \text{ ft}^3$$

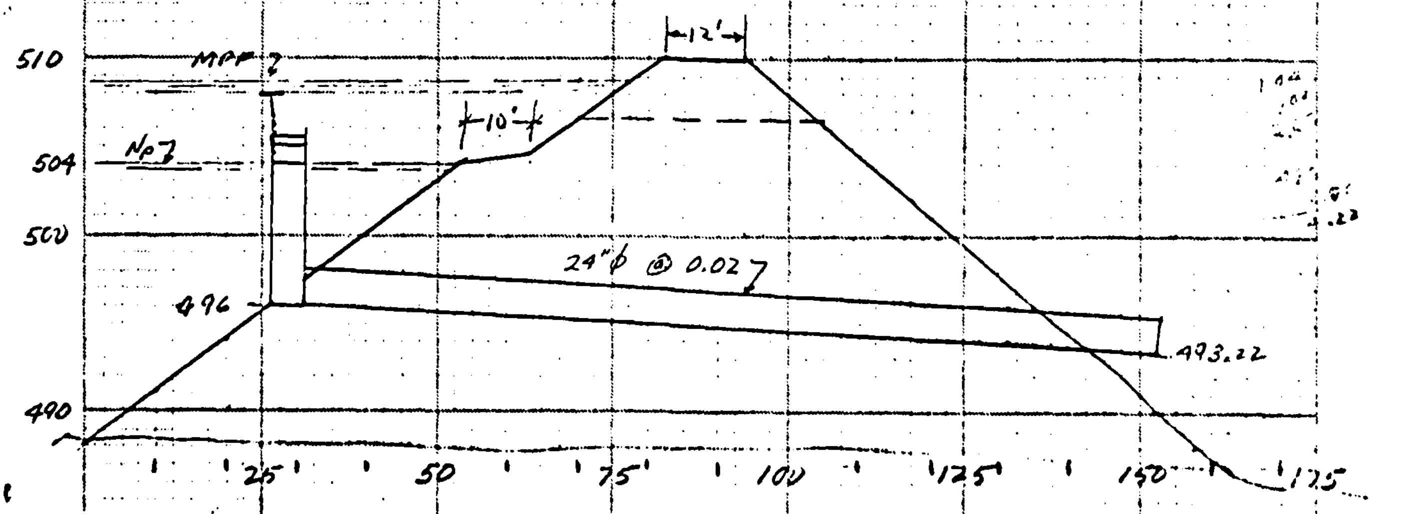
Required Discharge Rate:

$$Q = \frac{7.4(10^6)}{3(24)(3600)} = 28.55 \text{ ft}^3/\text{sec}$$

$$h_{av} = \frac{504 + 496}{2} - 496 = 4 \text{ ft}$$

H = 10.5

L = 144 ft.	L = 144	L + H = 144 + 8 = 156 + 24 = 180
S_1 = 0.02	S = 0.06	S = 0.04
n = 0.012	n = 0.012	n = 0.012
Ke = 0.5	Ke = 0.5	Ke = 0.85
D = 24"	D = 24"	D = 24"
Q = 35.145 ft³/sec	Q = 49.5 ft³/sec.	Q_{ph} = 53 ft³/sec



SPECIALIZING IN WASTE WATER TREATMENT AND HANDLING

Old Hickory Lake (No. 3)

$C_n = 80 \qquad AD = 167 Ac.$

Volume 10 yr. Storm: P= 5.5" Q=3.3"

$$167(43560)\frac{3.3}{12} = 2\times10^6 ft^3 = 45.9 AF$$

V_e (Spring Lake) = 0

$E_{NP} = 504$

10 YR: $V_{NP} = 9.5\times10^6 ft^3$

$V_{10} = 2.0\times10^6$

$V_{NP+10} = 11.5\times10^6 ft^3$

$E_{NP+10} = 505.5'$

Volume 100 Yr. Storm: P=7.5"; Q=5.2"

$$167(43560)\left(\frac{5.2}{12}\right) = 3.15\times10^6 ft^3$$

$$V_e (\text{Spring Lake}) = [2.85 + 3.5 - 5.09]10^6 = 1.26\times10^6 ft^3$$

$V_{NP} = 9.5\times10^6 ft^3$

$V = 3.15\times10^6$

$V_e = 1.26\times10^6$

$13.91\times10^6 ft^3$

$E_{100+NP} = 507.2'$ (See Flood Routing for P=7.5")

Examine affect of failure of Spring Lake Dam.

	VOLUME V. $ft^3\times10^6$			RESULTING ELEV.	F'BD.
	SPRING	OLD HICKORY	TOTAL	$Q_0 = 0$	
NP	2.85	9.5	12.35	506.2	:4.8'
E_E= 10 YR	5.09	11.5	16.59	509.2	:1.8'

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6TH ANNUAL MEETING AMERICAN COLLEGE OF SURVEYORS IN TENNESSEE

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Old Hickory Lake (No 3) MPF

$C_N = 80$

$DA = 167\ AC = 0.261 mi^2$

$P = 24''$

$T_c = \left(\frac{11.9L^3}{H}\right)^{0.385} = \left(\frac{11.9(\frac{1575}{5280})^3}{121}\right)^{0.385} = 0.101 hr.$

$Q = 21.3''$

5 family #1

6 $T_o = 5.71 hr.$

7 $T_p = 0.7T_c = 0.7(0.101) = 0.07 hr.$

8. $\frac{T_o}{T_p} = \frac{5.71}{0.07} = 80.4$

9 $\frac{T_o}{T_p}(Rev) = 75$

10 $T_p(Rev) = \frac{5.71}{75} = 0.076 hr.$

11. $q_p = \frac{484A}{T_p} = \frac{484(0.26)}{0.076} = 1656\ ft^3/sec/in$

12. $Q_{qp} = Q \times q_p = 21.3(1656) = 35273\ ft^3/sec$

13 $Q_1 = 0.09(35273) = 3175\ ft^3/sec$

$Q_1 = Q_1 + Q_e(Lake\ No. 2) = 3175 + 1470 = 4655\ ft^3/sec.$

14. $V_1 = 53.3QA = 53.3(21.3)(0.261) = 296.31 AF = 12.91 \times 10^6 ft^3$

$V_{1max} = V_1 + V_e(Lake\ 2) = (12.91 + 12.3)10^6 = 25.21 \times 10^6 ft^3$

$V_e(Lake) = V_1 - V_{sp}$
$= 331.5 - 49.36$
$= 282.14\ AF$
$= 12.3 \times 10^6 ft^3$

15. $V_{of} = 9.5 \times 10^6 = 218.09 AF$

16. $V_{sp} = V_{ee} - V_{of} = (13 - 9.5)10^6 = 3.5 \times 10^6 = 80.35 AF$

17 $\frac{V_{sp}}{V_1} = \frac{3.5 \times 10^6}{25.2 \times 10^6} = 0.14$

d. Compute the available flood storage at E_h

$V_{s2} = V_{th} - V_{uf}$

e. Follow steps 1 through 5 of the procedure given under principal spillway corrections for two stage structures

4. Principal Spillway System Calculations:

E_e = 506.5 ft	z = ______	L = ______ ft
V_{te} = 13×10^6 AF	Case ______	S_o = ______ %
V_{sp} = 3.5×10^6 AF	Q_h = 47.4 cfs	
Q_{ph} = 47 cfs	Q_h/Q_I = 0.009	

V_{sp}/V_I =	0.14
$V_{sp}/V_I + V_{s2}/V_I$ =	0.14
V'_{sp}/V_I =	$\boxed{0.16}$
V_{op}/V_I =	0.02

a. Select an elevation of emergency spillway crest, E_e

b. Read the total storage at E_e from the stage-storage curve, this is V_{te}

c. Compute the available flood storage at E_e
$V_{sp} = V_{te} - V_{uf}$

d. Obtain principal spillway discharge at E_e, this is Q_{ph}

e. Compute the average high stage release rate, this is Q_h

f. Follow the procedure given for single stage structures, or steps 6 through 10 for two stage structures, principal spillway corrections

g. Compute the principal spillway correction

$V_{op}/V_I = V'_{sp}/V_I - V_{sp}/V_I$ = 0.16 − 0.14 = 0.02

h. Obtain from the emergency spillway layout data

(1) Entrance Length, L $\frac{V_{sw}'}{V_I} = \frac{V_{sw}}{V_I} + \frac{V_{op}}{V_I}$

(2) Profile case

(3) Entrance slope, S_o =

(4) Side slopes, z

5. [illegible]:

1	[illegible]	[illegible]	[illegible]	5	6	[illegible]	8	9	10	11	12
E_w ft	[illegible]	[illegible]	$/V_I$	V'_{sw}/V_I	Q_o	ft	cfs	H_p ft	Q_e/b	b ft	[illegible]

AD-A108 466 TENNESSEE STATE DEPT OF CONSERVATION NASHVILLE DIV O--ETC F/G 13/13
NATIONAL PROGRAM OF INSPECTION OF NON-FEDERAL DAMS, TENNESSEE. --ETC(U)
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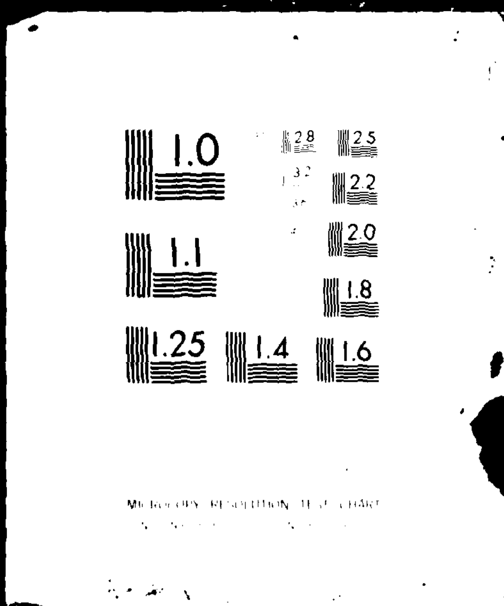

RESERVOIR FLOOD ROUTING CHARTS. 1/75

6

$E_F = 506.5$

$P = 24''$

$Q_1 = 4655$ cfs

$V_1 =$ [illegible]

$\frac{V_{sp}}{V_1} = \frac{3.5}{24.82} = 0.140$

$\frac{V_{sp}}{V_1} = 0.160$

1	2	3	4	5	6	7	8	9	10	11	12	L = 0	
E_w ft	V_{tw} AF	V_{sw} AF	V_{sw}/V_I	V'_{sw}/V_I	Q_0/Q_I	Q_0 cfs	Q_o cfs	H_p ft	Q_o/D	D ft	V fps	l_D	p
[illegible]		[illegible]	0.387	0.407	0.5	2323	2281	4.5	26.4	[illegible]		32.0	71
[illegible]	[illegible]	[illegible]	0.334	0.354	0.61	2840	2793	3.5	17.2	[illegible]		21.6	1?9
[illegible]	[illegible]	[illegible]	0.306	0.326	0.67	3119	3072	3	13.2	[illegible]		16.7	[illegible]
[illegible]	[illegible]	[illegible]	0.278	0.293	0.72	3352	3305	[illegible]	9.78	[illegible]		12.6	764
[illegible]	[illegible]	[illegible]	0.250	0.270	0.78	3631	[illegible]	2.	6.4	[illegible]		8.75	[illegible]
[illegible]	[illegible]	[illegible]	0.226	0.246	0.83	3864	3817	[illegible]	3.92	[illegible]		5.7	[illegible]
[illegible]	[illegible]	[illegible]	0.205	0.225	0.88	4096	4049	1	1.94	[illegible]		3.12	[illegible]
[illegible]	[illegible]	[illegible]	0.165	0.185	0.91	4236	4189	.5	0.58	7122		1.1	3808

$E_E = 507.5$

$V_1 = 25.?\times10^6$

$\frac{V_{sp}}{V_1} = \frac{2}{25.2} = 0.167$

$\frac{V_{sp}}{V_1} = 0.195$ 167 .027

508		5.6	0.226	0.253	0.88	4096	[illegible]	.5	0.58		
508.5		6.2	0.250	0.277	0.83	3864	3917	1.0	1.94		
509		6.9	0.278	0.305	0.76	3538	[illegible]	1.5	3.92		
509.5		7.6	0.306	0.333	0.7	3259	3212	2.0	6.4		
510		8.3	0.334	0.361	0.66	3072	3025	2.5	9.78		
510.5								3	13.2		
511		9.6	0.387	0.414	0.6	2793	2746	3.5	17.2		

$E_c = 506.5$

$H_p = 3.9$

$= 510.4$

F.Brd 6

511.0

$Q_c = 2600$ cfs

$d_c = 1.635'$

$v_c = 11.4$ fps

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OLD HICKORY LAKE
1/5/76 JR

$P = 13''$ $C_n = 80$

$T_c = 0.101$

$Q = 10.5''$

Found 1

$T_o = 5.71$ hr.

$T_p = 0.07$

$T_r/T_o = 80.4$

T_r/T_o (Rec) = 75

$T_p = 0.076$ hr.

$q_p = 1656$ ft³/sec/in

$Q_{qp} = 10.5(1656) = 17388$ ft³/sec

$Q_1 = 0.09(17388) = 1565$ ft³/sec

$Q_1 = Q_1 + Q_e$ (SPRING LAKE)

$Q_1 = 1565 + 575$

$Q_1 = 2140$ ft³/sec.

$V_1 = 53.33(10.5)(0.261) = 146.2$ AF $= 6.37 \times 10^6$ ft³

$V_1 = V_1 + V_e$ (SPRING LAKE)

$V_1 = (6.37 + 4.97)10^6$

$V_1 = 11.34 \times 10^6$ ft³

$V_e = V_1 - V_{sp}$

$= (7.12 - 2.15)10^6$

$= 4.97 \times 10^6$

$V_{sp} = (13 - 9.5)10^6 = 3.5 \times 10^6$ ft³

$\frac{V_{sp}}{V_1} = \frac{3.5 \times 10^6}{11.34 \times 10^6} = 0.307$

d. Compute the available flood storage at E_h

$V_{s\ell} = V_{th} - V_{uf}$

e. Follow steps 1 through 5 of the procedure given under principal spillway corrections for two stage structures

4. Principal Spillway System Calculations:

E_e = 506.5 ft	z = ______	L = ______ ft	V_{sp}/V_I = 0.307
V_{te} = 13X10⁶ ~~AF~~	Case ______	S_o = ______ %	$V_{sp}/V_I + V_{o\ell}/V_I$ = 0.307
V_{sp} = 3.5X10⁶ ~~AF~~	Q_h = 42.4 cfs		V'_{sp}/V_I = $\boxed{0.33}$
Q_{ph} = 47 cfs	$Q_h/Q_I = \frac{42.4}{[illegible]} = 0.009$		V_{op}/V_I = 0.023

a. Select an elevation of emergency spillway crest, E_e

b. Read the total storage at E_e from the stage-storage curve, this is V_{te}

c. Compute the available flood storage at E_e
$V_{sp} = V_{te} - V_{uf}$

d. Obtain principal spillway discharge at E_e, this is Q_{ph}

e. Compute the average high stage release rate, this is Q_h

f. Follow the procedure given for single stage structures, or steps 6 through 10 for two stage structures, principal spillway corrections

g. Compute the principal spillway correction

$V_{op}/V_I = V'_{sp}/V_I - V_{sp}/V_I = 0.330 - 0.307 = 0.023$

h. Obtain from the emergency spillway layout data

(1) Entrance Length, L

(2) Profile case

(3) Entrance slope, S_o

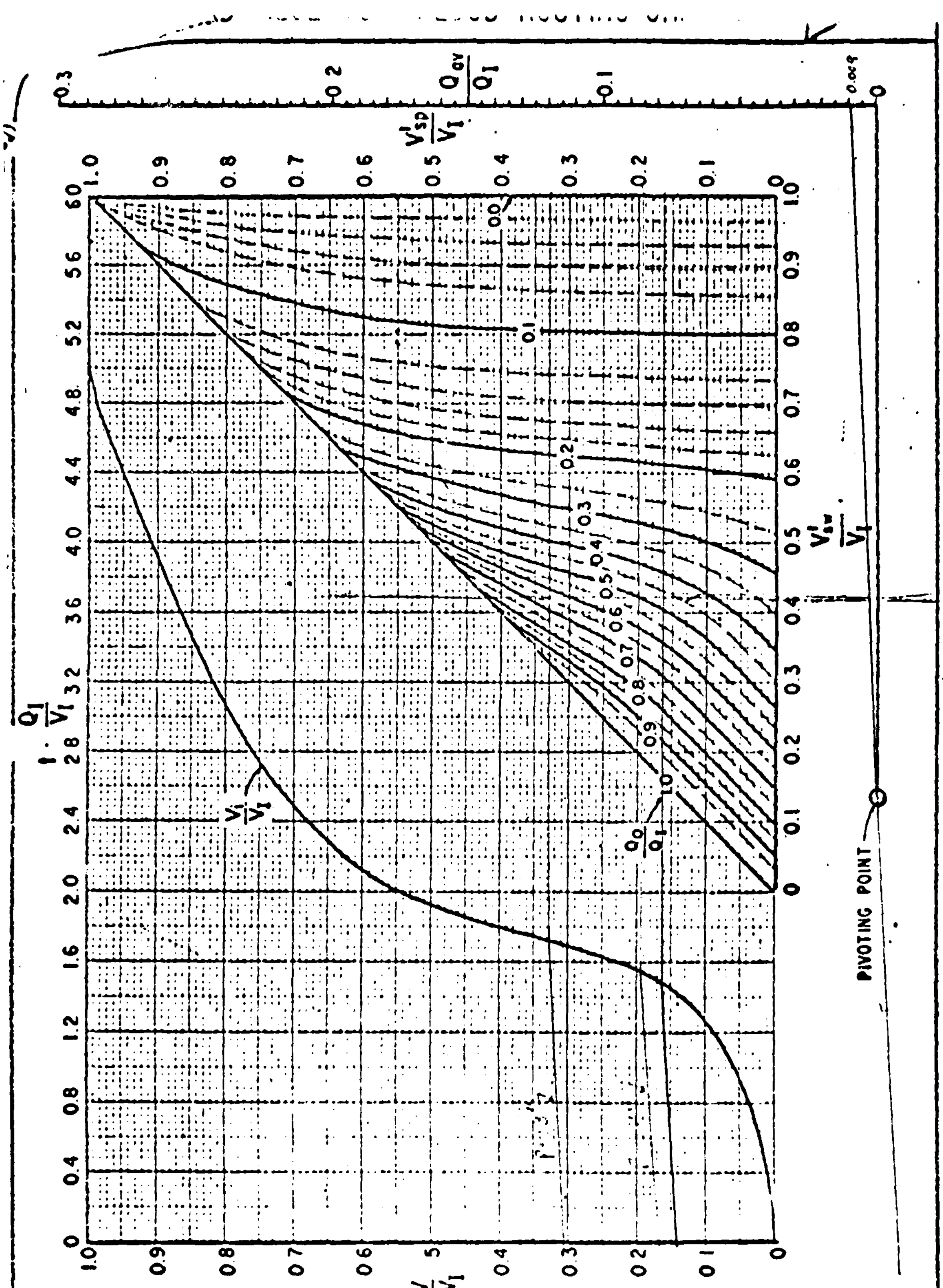
(4) Side slopes, z

5. Routing: $Q_I = 2140$ cfs $V_I = 11.34 \times 10^6$ ft³

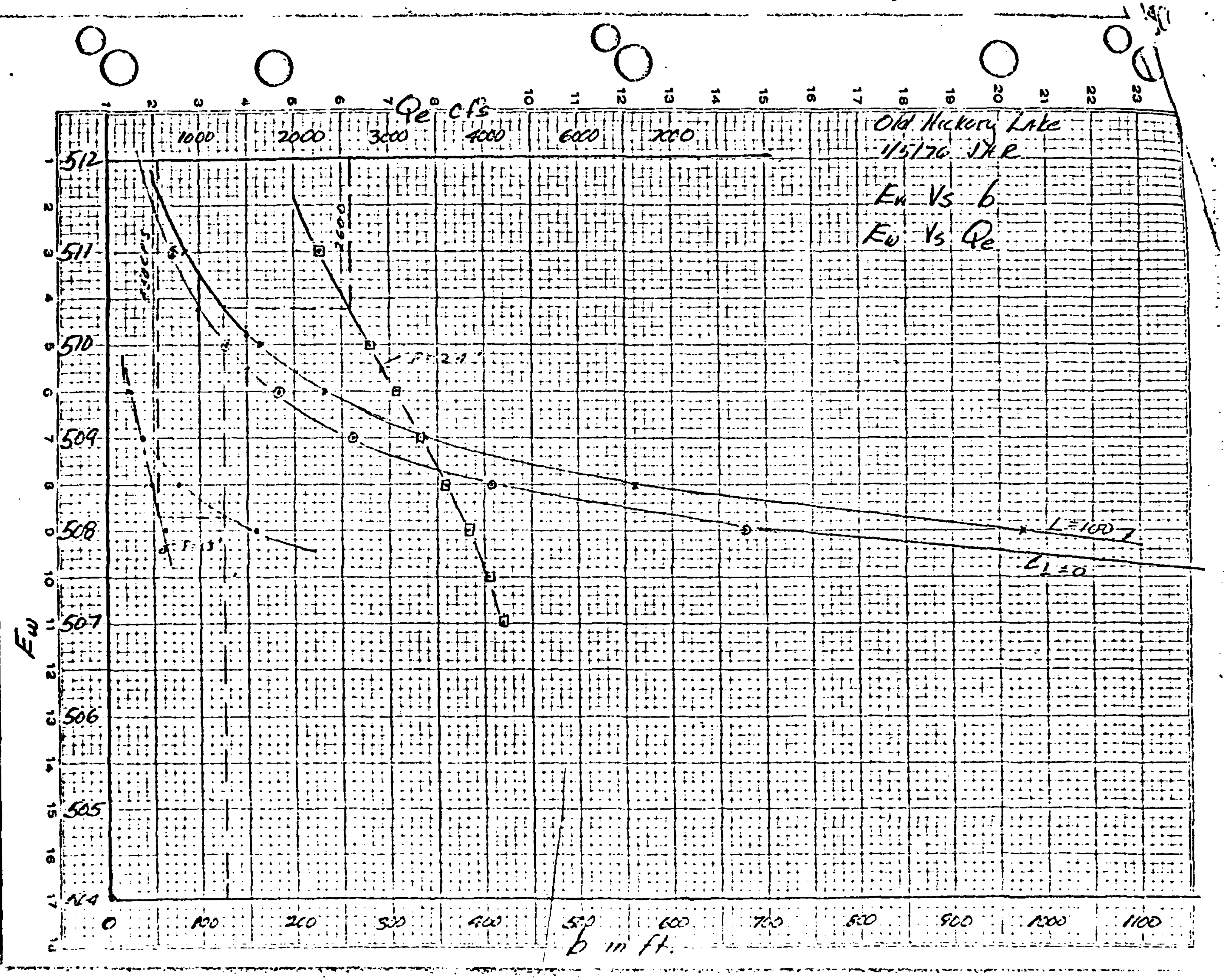
1	2	3	4	5	6	7	8	9	10	11	12
E_w ft	V_{tw} ~~AF~~	V_{sw} AF	V_{sw}/V_I	V'_{sw}/V_I	Q_o/Q_I	Q_o cfs	Q_e cfs	H_p ft	Q_e/b	b ft	v fps
509.5	17.1	7.6	0.67	0.623	0.15	321	[illegible]	3	[illegible]	[illegible]	
509	16.4	6.9	0.608	0.631	0.2	428	391	2.5	[illegible]	59	
508.5	15.7	6.2	0.547	0.570	0.25	535	495	2	[illegible]	[illegible]	
508	15.1	5.9	0.52	0.543	0.31	663	613	1.5	3.97	[illegible]	

$E_e = 506.5$
$H_p = 1.65$
$E_w = 508.15$
$Q_e = 550$ cfs

$d_c = 0.68'$
$V_e = 6.4$ ft/s

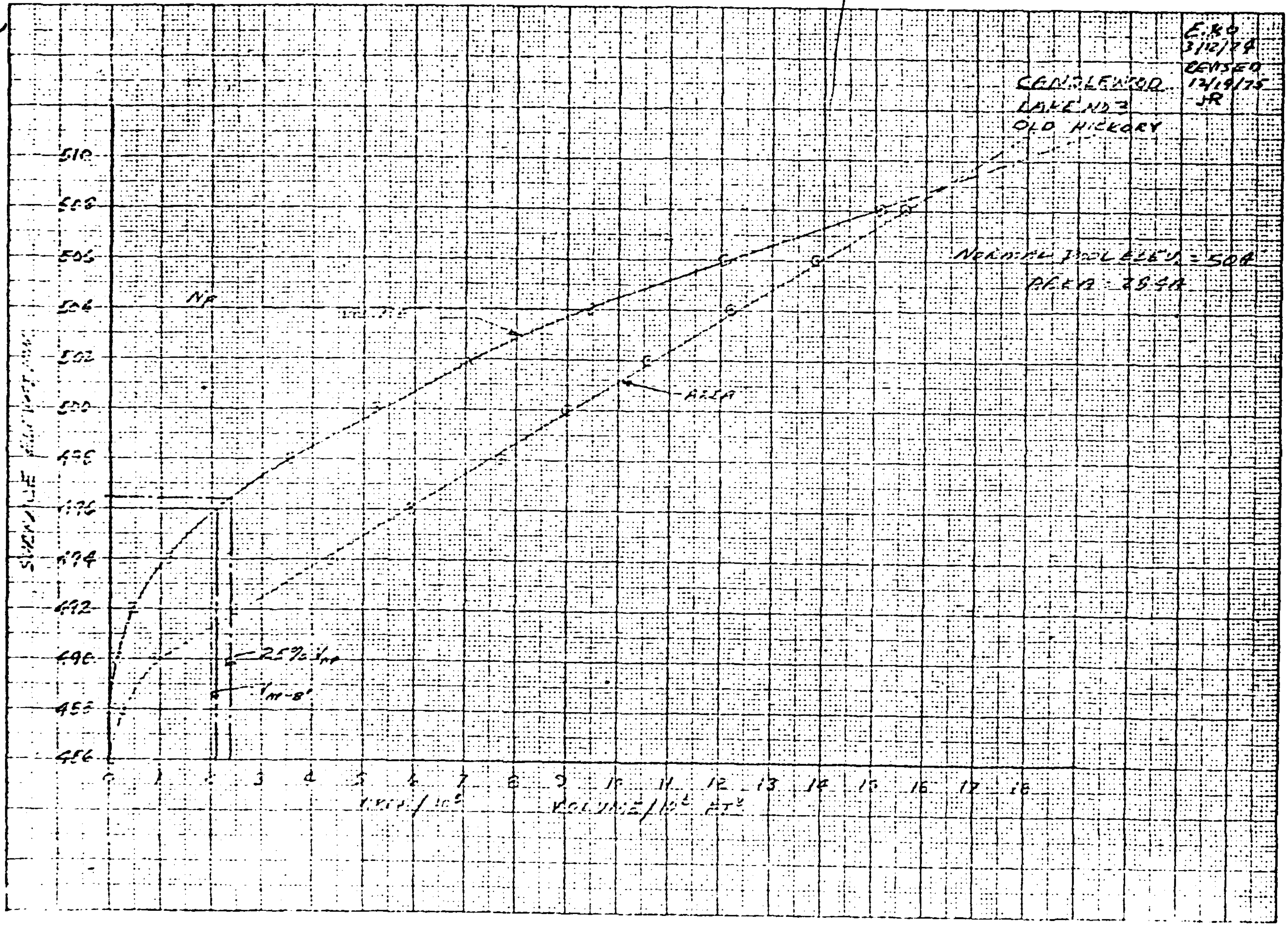


REFERENCE	U S DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE Prepared By REGIONAL TECHNICAL SERVICE CENTER UPPER DARBY, PENNSYLVANIA	STANDARD DWG NO. ES-601 SHEET 12 OF 12 DATE November, 1965



Old Hickory Lake
1/5/76 JAR
E_w Vs b
E_w Vs Q_e
Q_e cfs
1000
2000
3000
4000
6000
7000
E_w
512
511
510
509
508
507
506
505
NA
b in ft.
0
100
200
300
400
500
600
700
800
900
1000
1100
L=100
L=0

OLD HICKORY LAKE (No. 3)



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Principle Spillway Sizing

Criteria: Lower Lake to Elev. 496 (8') within 3 days

$$N_p = 504 - 8 = 496$$

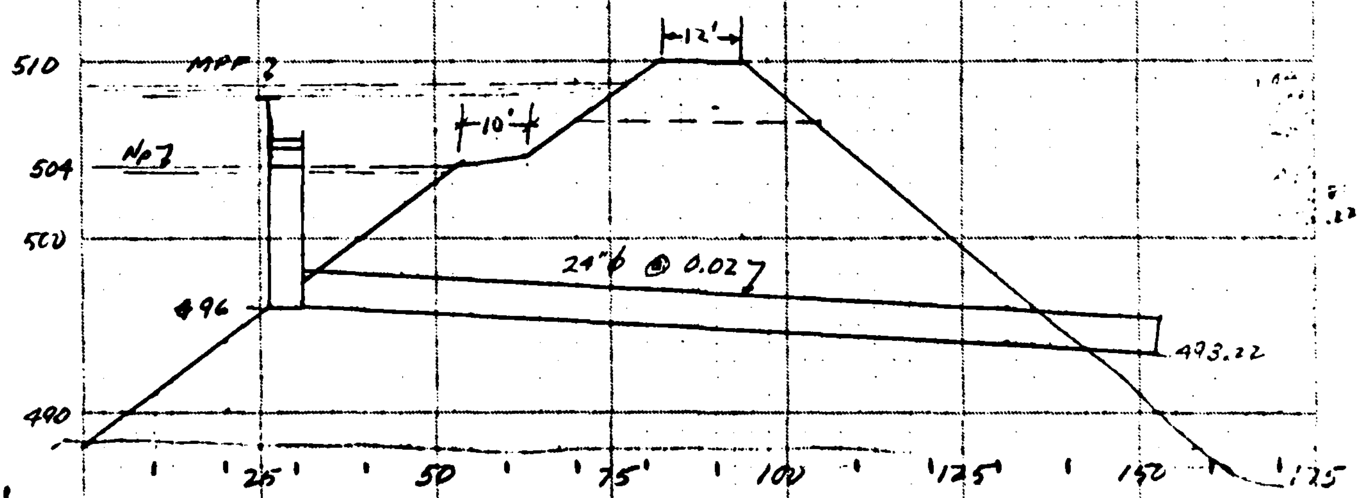
$$V_{Np} = 9.5 \times 10^6 \ ft^3$$
$$V_{496} = 2.1 \times 10^6$$
$$7.4 \times 10^6 \ ft^3$$

Required Discharge Rate:

$$Q = \frac{7.4(10^6)}{3(24)(3600)} = 28.55 \ ft^3/sec$$

$$h_{ave} = \frac{504+496}{2} - 496 = 4 \ ft \qquad H = 10.5$$

$L = 144$ ft.	$L = 144$	$L + H = 144 + 8 = 156 + 24 = 180'$
$S_1 = 0.02$	$S = 0.06$	$S - 0.04$
$n = 0.012$	$n = 0.012$	$n = 0.012$
$K_e = 0.5$	$K_e = 0.5$	$K_e = 0.85$
$D = 24''$	$D = 24''$	$D = 24''$
$Q = 35.145 \ ft^3/sec$	$Q = 49.5 \ ft^3/sec.$	$Q_{ph} = 53 \ ft^3/sec$



SPECIALIZING IN WASTE WATER TREATMENT AND HANDLING

JR

WELCOME TO
6TH ANNUAL MEETING AMERICAN COLLEGE OF SURVEYORS IN TENNESSEE

Old Hickory Lake (No 3)
$C_n = 80$ AD = 1070 Ac.

Volume Var. Storm: P = 5.5" Q = 3.3"

$137(43560)\frac{3.3}{12} = 2\times10^6 ft^3 = 45.9 AF$

Q_o (Spring Lake) = 0

E_{np} = 504

10 YR. $V_{np} = 9.5\times10^6 ft^3$
$V_{10} = 2.0\times10^6$
V_{NP+10} = $11.5\times10^6 ft^3$

E_{NP+10} = 505.5'

Volume 100 Yr. Storm: P = 7.5" Q = 5.2"
$137(43560)(\frac{5.2}{12}) = 3.15\times10^6 ft^3$

V_e (Spring Lake) = $[2.85 + 3.5 - 5.09]10^6 = 1.26\times10^6 ft^3$

$V_{NP} = 9.5\times10^6 ft^3$
$V = 3.15\times10^6$
$V_e = 1.26\times10^6$
$13.91\times10^6 ft^3$

E_{100+NP} = 507.2' (See Flood Routing for P = 7.5")

Examine affect of failure of Spring Lake Dam

	VOLUME V. $ft^3\times10^6$			RESULTING ELEV.	F'BD.
	SPRING	OLD HICKORY	TOTAL	$Q_o = 0$	
NP	2.85	9.5	12.35	506.2	4.8'
E_E = 10 YR	5.09	11.5	16.59	509.2	1.8'

1/5/76 JHK

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6TH ANNUAL MEETING AMERICAN COLLEGE OF SURVEYORS IN TENNESSEE

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Old Hickory Lake (No 3) MPF

C_N: 80

DA = 167 AC = 0.261 mi^2

P = 24"

$T_c = \left(\frac{11.9L^3}{H}\right)^{0.385} = \left(\frac{11.9(\frac{1525}{5280})^3}{121}\right)^{0.385} = 0.101$ hr.

Q = 21.3"

5 Lamda #1

6 T_0 = 5.71 hr.

7 $T_p = 0.7T_c = 0.7(0.101) = 0.07$ hr.

8. $\frac{T_0}{T_p} = \frac{5.71}{0.07} = 80.4$

9 $\frac{T_0}{T_p}$(Rev) = 75

10 T_p(Rev) = $\frac{5.71}{75}$ = 0.076 hr.

11. $q_p = \frac{484A}{T_p} = \frac{484(0.26)}{0.076}$ = 1656 ft^3/sec/in

12. $Q_{qp} = Q \times q_p = 21.3(1656) = 35273$ ft^3/sec

13 $Q_1 = 0.09(35273) = 3175$ ft^3/sec

$Q_1 = Q_1 + Q_e$(Lake No 2) = 3175 + 1470 = 4655 ft^3/sec

14. $V_1 = 53.3QA = 53.3(21.3)(0.261) = 296.31$ AF = 12.91×10^6 ft^3

$V_{inflow} = V + V_e$(Lake 2) = $(12.91 + 12.3)10^6$ = 25.21×10^6 ft^3

V_e(Lake) = $V_1 - V_{sp}$
= 331.5 − 49.36
= 282.14 AF
= 12.3×10^6 ft^3

15. $V_{of} = 9.5 \times 10^6$ = 218.09 AF

16. $V_{sp} = V_{ee} - V_{of} = (13 - 9.5)10^6 = 3.5 \times 10^6$ = 80.35 AF

17 $\frac{V_{sp}}{V_1} = \frac{3.5 \times 10^6}{25.2 \times 10^6} = 0.14$

d. Compute the available flood storage at E_h

$$V_{s2} = V_{th} - V_{uf}$$

e. Follow steps 1 through 5 of the procedure given under principal spillway corrections for two stage structures

4. Principal Spillway System Calculations:

E_e = 506.5 ft	z = ______	L = ______ ft	V_{sp}/V_I = 0.14
V_{te} = 13×10^6 AF	Case ______	S_o = ____ %	$V_{sp}/V_I + V_{s2}/V_I$ = 0.14
V_{sp} = 3.5×10^6 AF	Q_h = 47.4 cfs		V'_{sp}/V_I = $\boxed{0.16}$
Q_{ph} = 47 cfs	Q_h/Q_I = 0.009		V_{op}/V_I = 0.02

a. Select an elevation of emergency spillway crest, E_e

b. Read the total storage at E_e from the stage-storage curve, this is V_{te}

c. Compute the available flood storage at E_e
$$V_{sp} = V_{te} - V_{uf}$$

d. Obtain principal spillway discharge at E_e, this is Q_{ph}

e. Compute the average high stage release rate, this is Q_h

f. Follow the procedure given for single stage structures, or steps 6 through 10 for two stage structures, principal spillway corrections

g. Compute the principal spillway correction

$$V_{op}/V_I = V'_{sp}/V_I - V_{sp}/V_I \quad = 0.16 - 0.14 = 0.02$$

h. Obtain from the emergency spillway layout data

(1) Entrance Length, L

(2) Profile case

(3) Entrance slope, S_o

(4) Side slopes, z

$$\frac{V_{sw}'}{V_I} = \frac{V_{sw}}{V_I} + \frac{V_{op}}{V_I}$$

$$=$$

5. [illegible]:

1	[illegible]	[illegible]	5	6	[illegible]	8	9	10	11	[illegible]
E_w ft	[illegible]	[illegible]$/V_I$	V'_{sw}/V_I	Q_o	[illegible] ft	[illegible] cfs	H_p ft	Q_e/b	b ft	[illegible]

[illegible] 1/5/76 [illegible]

$= 50?.5$

$P = 24''$

$Q_1 = 4655$ cfs

$V_1 =$ [illegible]

$\frac{V_{sp}}{V_1} = \frac{3.5}{24.82} = 0.140$

$\frac{V_{sp}}{V_1} = 0.160$

1	2	3	4	5	6	7	8	9	10	11	12
E_w ft	V_{tw} AF	V_{ow} AF	V_{ow}/V_I	V'_{ow}/V_I	Q_o/Q_I	Q_o cfs	Q_o cfs	H_p ft	Q_o/o	b ft	v fps
[illegible]		[illegible]	0.387	0.407	0.5	2323	2281	4.5	26.4	[illegible]	
[illegible]	[illegible]	[illegible]	0.334	0.354	0.61	2840	2793	3.5	17.2	[illegible]	
[illegible]	[illegible]	[illegible]	0.306	0.326	0.67	3119	3072	3	13.2	[illegible]	
	[illegible]	[illegible]	0.278	[illegible]	0.72	3352	3305	[illegible]	9.78	[illegible]	
[illegible]	[illegible]	[illegible]	0.250	0.270	0.78	3631	[illegible]	2.	6.4	[illegible]	
[illegible]	[illegible]	[illegible]	0.226	0.246	0.83	3864	3817	[illegible]	3.42	[illegible]	
[illegible]	[illegible]	[illegible]	0.205	0.225	0.88	4096	4049	1	1.94	[illegible]	
[illegible]	[illegible]	[illegible]	0.165	0.185	0.91	4236	4189	.5	0.58	7.22	
508		5.6	[illegible]	0.253	0.85	4096	[illegible]	.5	[illegible]		
508.5		6.2	0.250	0.277	0.83	3864	[illegible]	1.0	1.94		
509		6.9	0.278	0.305	0.76	[illegible]	[illegible]	1.5	[illegible]		
509.5		7.6	0.306	0.333	0.7	3257	3212	2.0	6.4		
510		8.3	0.334	0.361	0.66	3072	3025	2.5	[illegible]		
510.5								3	[illegible]		
511		9.6	0.387	0.414	0.6	2793	2746	3.5	17.2		

[illegible] = 0	
D	P
32.0	[illegible]
21.6	[illegible]
16.7	[illegible]
12.6	[illegible]
8.18	[illegible]
5.7	[illegible]
3.12	[illegible]
1.1	[illegible]

$E_s = 50?.5$

$V = 25$ [illegible]

$\frac{V_{sp}}{V_1} =$ [illegible]

$\frac{V_{sp}}{V_1} = 0.195$

$E_c = 506.5$

$H_p = 3.9$

$-\omega = 510.4$

F.[illegible] 6

511.0

$Q_e = 2600$ [illegible]

$d_e = 1.635'$

$v_e = 11.4$ fps

WELCOME TO

6TH ANNUAL MEETING AMERICAN COLLEGE OF SURVEYORS IN TENNESSEE

Old Hickory Lake
1/5/76 JR

$P = 13''$ $C_n = 80$

$T_c = 0.101$
$Q = 10.5''$
Form 1
$T_s = 5.71$ hr.
$T_p = 0.07$
$T_s/T_c = 50.4$

$q_p/A(in) = 95$

$T_p = 0.076$ hr.
$q_p = 1656$ ft³/sec/in
$Q_{tp} = 10.5(1656) = 17388$ ft³/sec
$Q_o = 0.09(17388) = 1565$ ft³/sec
$Q_1 = Q_1 + Q_o$ (SPRING LAKE)
$Q_1 = 1565 + 575$
$Q_1 = 2140$ ft³/sec.

$V_1 = 53.33(10.5)(0.261) = 146.2$ Ar $= 6.37 \times 10^6$ ft³

$V_1 = V_1 + V_e$ (SPRING LAKE)
$V_1 = (6.37 + 4.97)10^6$
$V_1 = 11.34 \times 10^6$ ft³

$V_e = V_1 - V_{sp}$
$= (7.12 - 2.15)10^6$
$= 4.97 \times 10^6$

$V_{sp} = (13 - 9.5)10^6 = 3.5 \times 10^6$ ft³

$$\frac{V_{sp}}{V_1} = \frac{3.5 \times 10^6}{11.34 \times 10^6} = 0.307$$

1/3/76

d. Compute the available flood storage at E_h

$V_{sl} = V_{th} - V_{uf}$

e. Follow steps 1 through 5 of the procedure given under principal spillway corrections for two stage structures

4. Principal Spillway System Calculations:

E_e = 506.5 ft	z = ______	L = ______ ft	V_{sp}/V_I = 0.307
V_{te} = 13X10[6] ~~AF~~	Case ______	S_o = ______ %	$V_{sp}/V_I + V_{ol}/V_I$ = 0.307
V_{sp} = 3.5X10[6] ~~AF~~	Q_h = 42.4 cfs		V'_{sp}/V_I = $\boxed{0.33}$
Q_{ph} = 47 cfs	$Q_h/Q_I = \frac{42.4}{[illegible]} = 0.009$		V_{op}/V_I = [illegible]

a. Select an elevation of emergency spillway crest, E_e

b. Read the total storage at E_e from the stage-storage curve, this is V_{te}

c. Compute the available flood storage at E_e

$V_{sp} = V_{te} - V_{uf}$

d. Obtain principal spillway discharge at E_e, this is Q_{ph}

e. Compute the average high stage release rate, this is Q_h

f. Follow the procedure given for single stage structures, or steps 6 through 10 for two stage structures, principal spillway corrections

g. Compute the principal spillway correction

$V_{op}/V_I = V'_{sp}/V_I - V_{sp}/V_I$ = 0.330 - 0.307 = 0.023

h. Obtain from the emergency spillway layout data

(1) Entrance Length, L

(2) Profile case

(3) Entrance slope, S_o

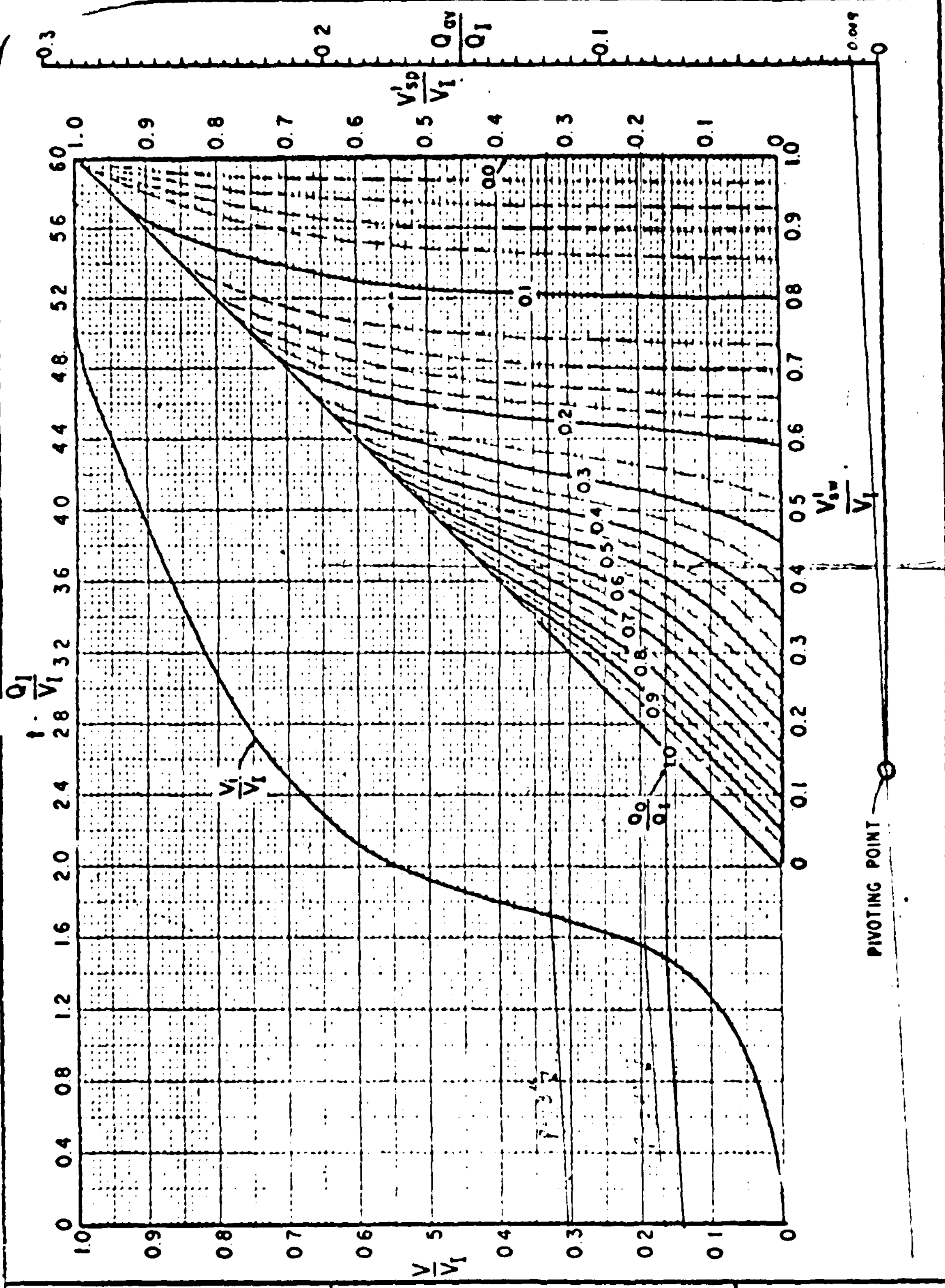
(4) Side slopes, z

5. Routing: Q_I = 2140 cfs V_I = 11.34X10[6] ft[3]

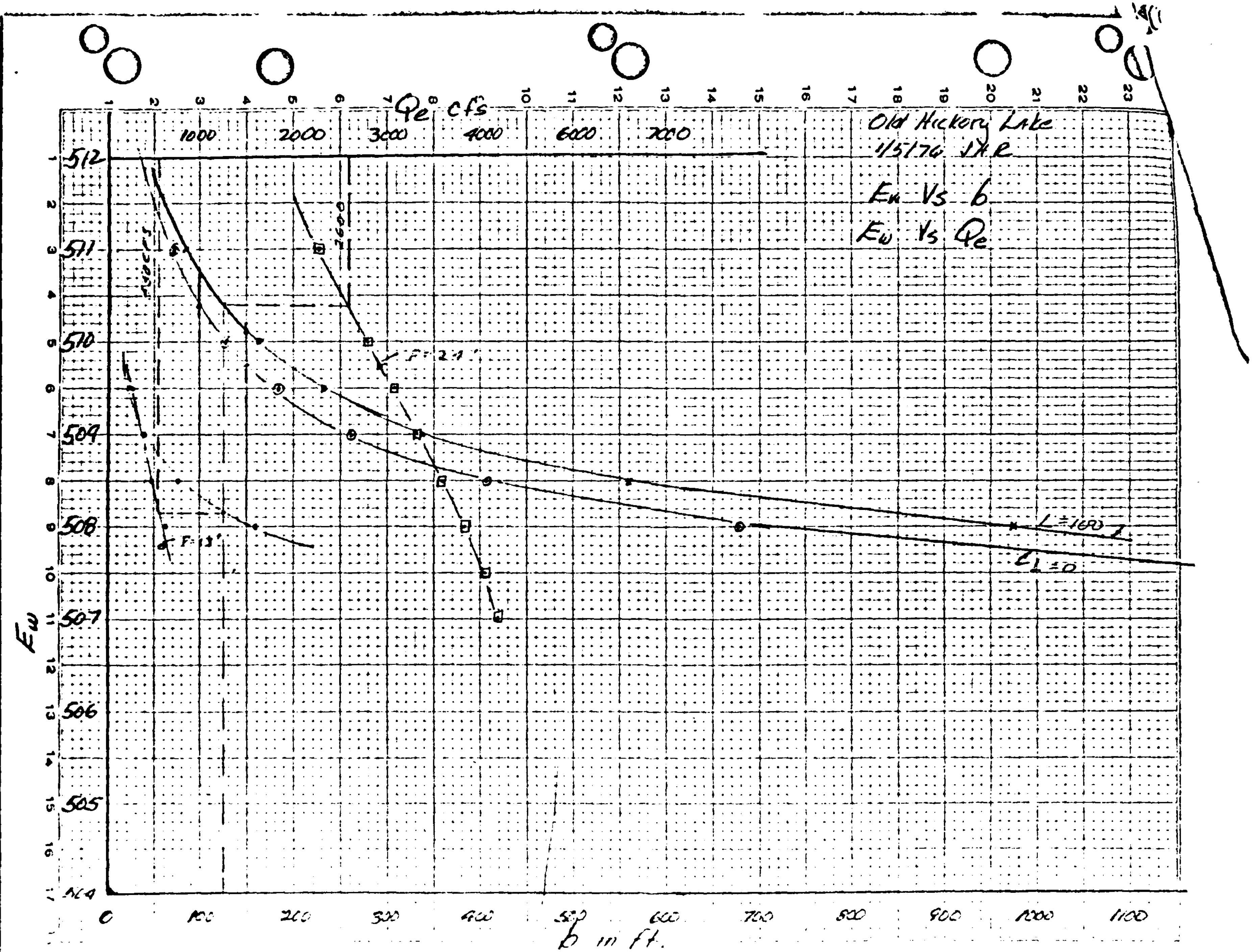
1	2	3	4	5	6	7	8	9	10	11	12
E_w ft	V_{tw} ~~AF~~	V_{sw} AF	V_{sw}/V_I	V'_{sw}/V_I	Q_o/Q_I	Q_o cfs	Q_e cfs	H_p ft	Q_e/b	b ft	v fps
509.5	17.1	7.6	0.67	[illegible]	0.15	[illegible]	[illegible]	3	[illegible]	[illegible]	
[illegible]	16.4	6.9	0.608	0.631	0.2	[illegible]	331	2.5	[illegible]	[illegible]	
508.5	15.7	6.2	0.547	0.570	0.25	535	[illegible]	2	[illegible]	[illegible]	
508	15.1	5.9	0.52	0.543	0.31	[illegible]	[illegible]	1.5	[illegible]	[illegible]	

E_e = 506.5
H_p = 1.65
E_w = 508.15
Q_e = [illegible] cfs

[illegible] = 0.68'
V_e = 6.4 ft/s



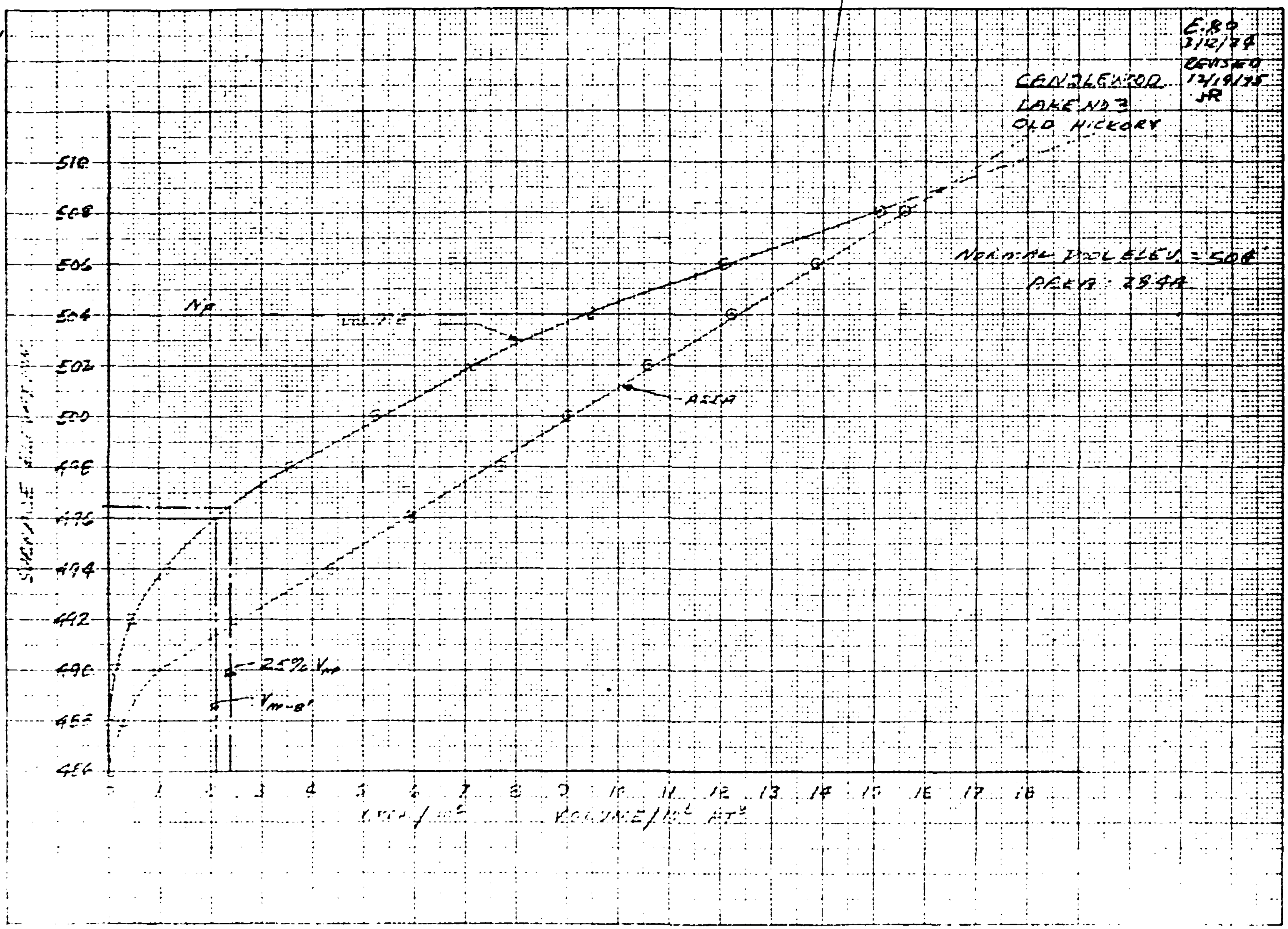
REFERENCE	U S DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE Prepared By REGIONAL TECHNICAL SERVICE CENTER UPPER DARBY, PENNSYLVANIA	STANDARD DWG NO. ES-601 SHEET 12 OF 12 DATE November, 1965


Old Hickory Lake
1/5/76 JHR
Ew Vs b
Ew Vs Qe
Qe cfs
1000
2000
3000
4000
6000
7000
512
511
510
509
508
507
506
505
Ew
0
100
200
300
400
500
600
700
800
900
1000
1100
b in ft.
F=2.4'
F=1.3'
L=100'
L=0
2600

Old Hickory Lake (No. 3)

K+E 10 X 10 TO THE CENTIMETER 18 X 25 CM. 46 1512 MADE IN U.S.A. KEUFFEL & ESSER CO.

506



SPRING LAKE
3/10/76 JR

FLOOD ROUTING $C_n = 80$

A. $P = 29.5"$ $Q = 26"$

$A_D = 187A = 0.292\ mi^2$

$T_c = \left[\frac{11.9\left(\frac{1750}{5280}\right)^3}{116}\right]^{0.385} = 0.1162 hr.$

5 Family #1

6 $T_o = 5.71$ hrs.

7. $T_p = 0.7T_c = 0.7(0.1162) = 0.0814$ hrs.

8. $T_o/T_p = \frac{5.71}{0.0814} = 70.2$

9 $T_o/T_p (Rev) = 75$

10 $T_p(Rev) = \frac{5.71}{75} = 0.0761$ Hrs.

11 $q_p = \frac{484A}{T_p} = \frac{484(0.292)}{0.0761} = 1857\ ft^3/sec/in$

12. $Q_{qp} = Q \times q_p = 26(1857) = 48282\ ft^3/sec.$

13 $Q_1 = 0.09Q_{qp} = 0.09(48282) = 4345.4\ ft^3/sec.$

14 $V_1 = 53.3(Q)A = 53.3(26)(0.292) = 404.7AF = 17.6 \times 10^6 ft^3$

$E_{NP} = 521$; $E_{SO} = 525$

15 $V_{uf} = 2.85 \times 10^6 ft^3 = 65.43AF$

16. $V_{sp} = V_{ce} - V_{uf} = (5.0 - 2.85)10^6 = 2.15 \times 10^6 ft^3$ (49.36AF)

17 $\frac{V_{sp}}{V_1} = \frac{49.36}{404.7} = 0.122$

B. $P = 12$, $Q = 9.5"$

$T_c = 0.1162$

5 Family #2

6 $T_o = 5.4$ hr.

7 $T_p = 0.7T_c = 0.7(0.1162) = 0.081$ hr.

8 $T_o/T_p = \frac{5.4}{0.081} = 66$

9 $T_o/T_p (Rev) = 75$

10 $T_p(Rev) = \frac{5.4}{75} = 0.072$ hr.

11 $q_p = \frac{484A}{T_p} = \frac{484(0.292)}{0.072} = 1963\ ft^3/sec/in$

7.

3/9/76
JR

OK [illegible] 4/17/76

SPRING LAKE

Volume

100 YR Storm

$P_{100} = 5.5''$ $Q = 3.3''$

$187 \times 43560 \times \frac{3.3}{12} = 2.24 \times 10^6\ ft^3$

$V_{NP} = 2.85 \times 10^6\ ft^3$

$V_{100} = \underline{2.24 \times 10^6}$

$5.09 \times 10^6\ ft^3$

$E_{100} = 525'$

$E_{SW} = 525'$

$P_{MP} = 29.5$ $Q = 26''$

8. $T_o/T_p = \frac{5.71}{0.0814} = 70.2$

9. $T_o/T_p(Rev) = 75$

10 $T_p(Rev) = \frac{5.71}{75} = 0.0761$ Hrs.

11. $q_p = \frac{484A}{T_p} = \frac{484(0.292)}{0.0761} = 1857$ ft³/sec/in

12. $Q_{qp} = Q \times q_p = 26(1857) = 48282$ ft³/sec.

13 $Q_1 = 0.09Q_{qp} = 0.09(48282) = 4345.4$ ft³/sec.

14. $V_1 = 53.3(Q)A = 53.3(26)(0.292) = 404.7AF = 17.6 \times 10^6$ ft³

$E_{np} = 521$; $E_{so} = 525$

15 $V_{uf} = 2.85 \times 10^6$ ft³ $= 65.43$ AF

16. $V_{sp} = V_{Eo} - V_{uf} = (5.0 - 2.85)10^6 = 2.15 \times 10^6$ ft³ (49.36 AF)

17 $\frac{V_{sp}}{V_1} = \frac{49.36}{404.7} = 0.122$

B. $P = 12$, $Q = 9.5''$

$T_c = 0.1162$

5 Family #2

6 $T_o = 5.4$ hr.

7 $T_p = 0.7T_c = 0.7(0.1162) = 0.081$ hr.

8 $T_o/T_p = \frac{5.4}{0.081} = 66$

9 $T_o/T_p(Rev) = 75$

10 $T_p(Rev) = \frac{5.4}{75} = 0.072$ hr.

11. $q_p = \frac{484A}{T_p} = \frac{484(0.292)}{0.072} = 1963$ ft³/sec/in

12 $Q_{qp} = 9.5(1963) = 18647$ ft³/sec

13 $Q_1 = 18647(0.079) = 1473$ ft³/sec

14 $V_1 = 53.3(9.5)(0.292) = 147.9AF = 6.4 \times 10^6$ ft³

$E_{np} = 521$ $E_{sw} = 525$

15 $V_{uf} = 2.85 \times 10^6$ ft³ (65.43AF) : 16. $V_{sp} = 2.15 \times 10^6$ ft³ (49.36AF)

18 $\frac{V_{sp}}{V_1} = \frac{49.36}{147.9} = 0.34$

JHR

$P = 29.5''$

$V_{UF} = 65.43$

$Q_I = 4345$ CFS

$V_I = 404.7$ AF

$\frac{V_{SP}}{V_I} = 0.122$

1	2	3	4	5	6	7	8	9	10	11	12
E_w ft	V_{tv} AF	V_{sv} AF	V_{sv}/V_I	V'_{sv}/V_I	Q_o/Q_I	Q_o cfs	Q_e cfs	H_p ft	Q_e/b	b ft	v fps
527.5	206.6	141.17	0.349		0.55		2390	4.5	26.4	91	
529	192.8	127.37	0.315		0.62		2694	4	21.5	125	
[illegible]	[illegible]	115.27	0.292		0.65		2824	3.5	17.2	164	
528	172.2	106.8	0.2[illegible]		0.7		3042	3	13.2	230	
527.5	153.8	88.37	0.21[illegible]		0.8		3476	2.5	9.73	355	
527	149.2	83.8	[illegible]		0.84		3650	2	6.4	570	
526.5	142.3	76.9	0.190		0.88		3824	1.5	3.92	976	
526	132	66.6	0.165		0.94		4084	1	1.94	2105	
529.3							745[illegible]	4.3	[illegible]	1[illegible]	
528	172.2	106.8	0.722		0.135		199	3	13.2	15	
527.5		88.37	0.597		0.21		309	2.5	9.78	32	
527		83.8	0.567		0.24		354	2	6.4	55	
526.5		76.9	0.52		0.3		442	1.5	3.92	113	
526		66.6	0.45		0.4		589	1	1.94	304	
526.9							425	1.6		100	6.2

$P = 12''$

$Q = 9.5''$

$Q_I = 1473$ CFS

$V_I = 147.9$

$\frac{V_{SP}}{V_I} = 0.34$

MPF

$E_{SW} = 525$

$H_P = 4.3$

$E_W = 529.3$

$F_{RB} = 1.7$

531.0

$b = 100'$

$P = 12''$

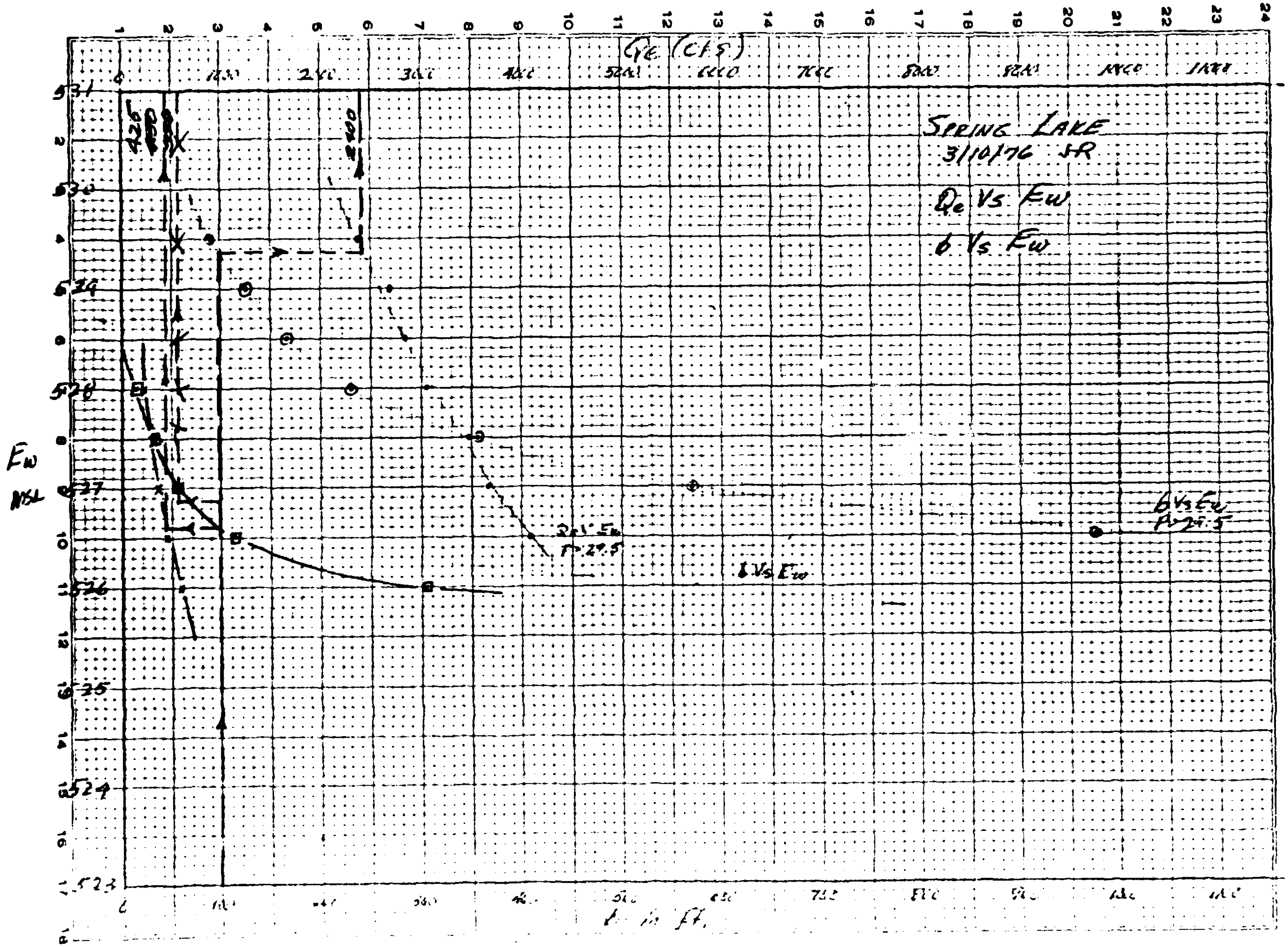
$E_{SW} = 525$

1.6

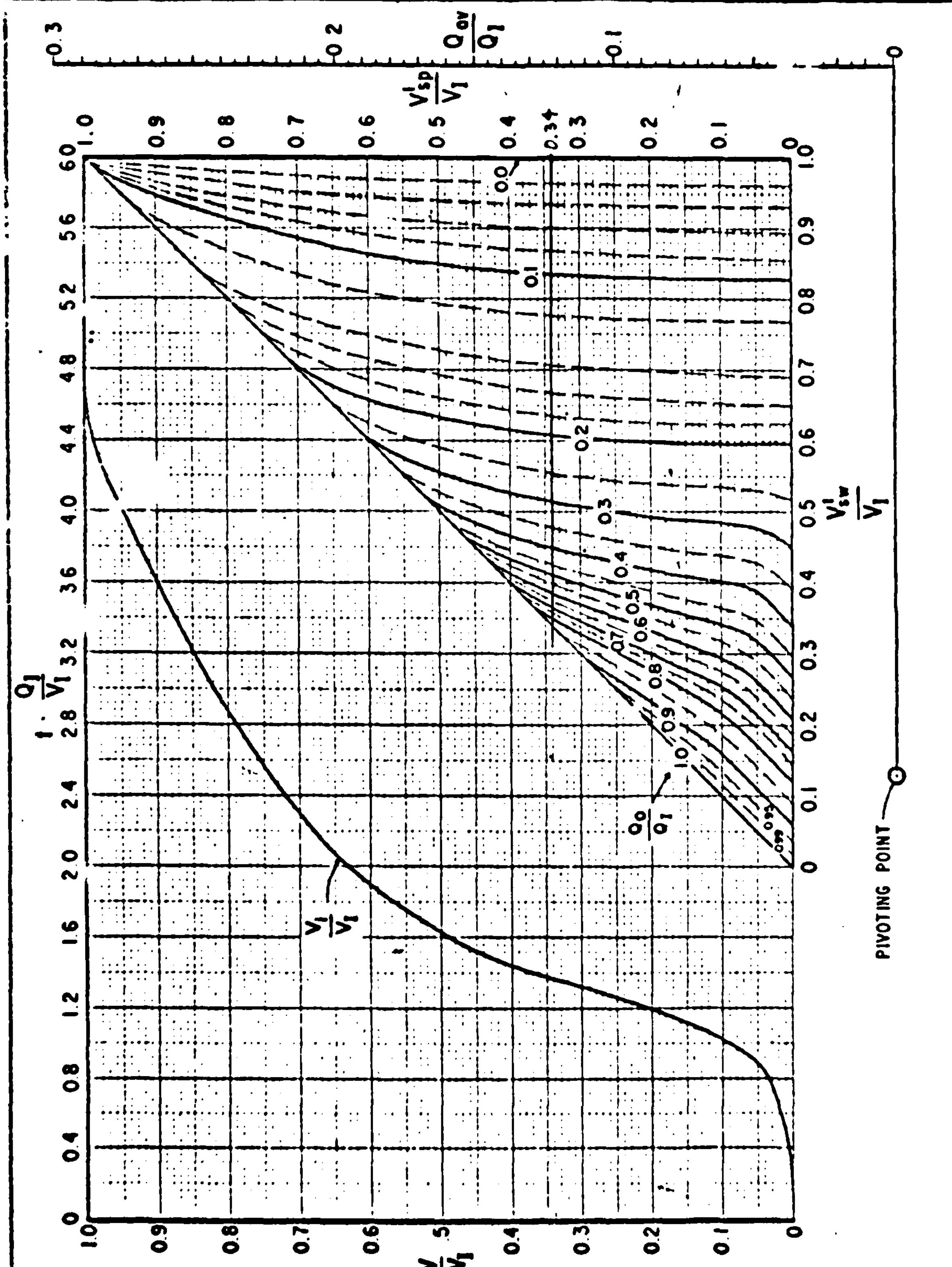
$E_W = 526.6$

$Q_e = 425$ CFS

$V = 6.2$



SPRING LAKE
3/10/76 SR
Q_e Vs E_w
b Vs E_w
Q_e (CFS)
E_w
MSL
531
530
529
528
527
526
525
524
523
b in ft.



REFERENCE	U S DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE Prepared By REGIONAL TECHNICAL SERVICE CENTER UPPER DARBY, PENNSYLVANIA	STANDARD DWG NO ES-602 SHEET 12 OF 12 DATE November, 1965

3/16/76

3/16/76

d. Compute the available flood storage at E_h

$V_{s\ell} = V_{th} - V_{uf}$

e. Follow steps 1 through 5 of the procedure given under principal spillway corrections for two stage structures

4. Principal Spillway System Calculations:

E_e = 505.5 ft	z = ____	L = ____ ft	V_{sp}/V_I = 0.189
V_{te} = 11.4X10⁶ AF	Case ____	S_o = ____ %	$V_{sp}/V_I + V_{o\ell}/V_I$ = 0.189
V_{sp} = 1.9X10⁶ AF	Q_h = 42.4 cfs		V'_{sp}/V_I = $\boxed{0.21}$
Q_{ph} = 47 cfs	Q_h/Q_I = 42.4/1782 = 0.024		V_{op}/V_I = 0.021

a. Select an elevation of emergency spillway crest, E_e

b. Read the total storage at E_e from the stage-storage curve, this is V_{te}

c. Compute the available flood storage at E_e
$V_{sp} = V_{te} - V_{uf}$

d. Obtain principal spillway discharge at E_e, this is Q_{ph}

e. Compute the average high stage release rate, this is Q_h

f. Follow the procedure given for single stage structures, or steps 6 through 10 for two stage structures, principal spillway corrections

g. Compute the principal spillway correction

$V_{op}/V_I = V'_{sp}/V_I - V_{sp}/V_I$

h. Obtain from the emergency spillway layout data

(1) Entrance Length, L

(2) Profile case

(3) Entrance slope, S_o

(4) Side slopes, z

5. Routing:

1	2	3	4	5	6	7	8	9	10	11	12
E_w ft	V_{tw} AF	V_{sw} AF	V_{sw}/V_I	V'_{sw}/V_I	Q_o/Q_I	Q_o cfs	Q_e cfs	H_p ft	Q_e/b	b ft	v fps

3/9/76
JR

OK
4/14/76
EBO

OLD HICKORY LAKE (No. 3)

VOLUME $C_n = 80$, $AD = 167AC$

100YR STORM $P = 5.5$, $Q = 3.3$

$167(43560)(\frac{3.3}{12}) = 2 \times 10^6 ft^3$

V_e (SPRING LAKE) = 0

$N_P = 504$

$V_{NP} = 9.5 \times 10^6 ft^3$

$V_{100} = \underline{2.0 \times 10^6}$

$V_{NP+100} = 11.5 \times 10^6 ft^3$

$E_{NP+100} = 505.5 ft$

$E_{SD} = 506.5$ OR 505.5

EXAMINE AFFECT OF FAILURE OF SPRING LAKE DAM

	VOLUME ($ft^3 \times 10^6$)				
CONDITIONS	SPRING	OLD HICKORY	TOTAL	RESULTING ELEV.	F'BRD.
NP	2.85	9.5	12.35	506.2	4.8'
$E_E = 100YR$	5.09	11.5	16.59	509.2	1.8'

OLD HICKORY LAKE (No 3)
3/9/76 JR

FLOOD ROUTING

A. $C_n = 80 \quad P = 29.5'' \quad Q = 26''$

$DA = 167\ AC = 0.261\ m^2$

$T_c = \left(\frac{11.9L^3}{H}\right)^{0.385} = \left(\frac{11.9\left(\frac{1575}{5280}\right)^3}{121}\right)^{0.385} = 0.101\ hr.$

5. Family #1.

6. $T_0 = 5.71\ hr.$

7. $T_p = 0.7T_c = 0.7(0.101) = 0.07\ hr.$

8. $T_0/T_p = \frac{5.71}{0.07} = 80.4$

9. $\frac{T_0}{T_p}(Rev) = 75$

10. $T_p(Rev) = \frac{5.71}{75} = 0.076\ hr.$

11 $q_p = \frac{484A}{T_p} = \frac{484(0.261)}{0.076} = 1656\ ft^3/sec/in$

12 $Q_{qp} = Q \times q_p = 26(1656) = 43056\ ft^3/sec$

13. $Q_1 = 0.09\ (43056) = 3875\ ft^3/sec$

14 $V_1 = 53.3QA = 53.3\ (26)(0.261) = 361.7AF = 15.8 \times 10^6\ ft^3$

$V_{1max} = V_1 + V_e(Lake\ \#2) = (15.8 + 15.48)10^6 = 31.28 \times 10^6\ ft^3$

$V_e(Lake\ \#2) = V_1 - V_{sp}$

$= 404.7 - 49.36$

$= 355.34\ AF$

$V_e = 15.48 \times 10^6\ ft^3$

15. $V_{uf} = 9.5 \times 10^6\ ft^3$

16 $V_{sp} = V_{te} - V_{uf} = (11.4 - 9.5) \times 10^6 = 1.9 \times 10^6\ ft^3$

17 $V_{sp}/V_1 = 1.9/31.3 = 0.061$

B. $P = 12'',\ Q = 9.5''$

5 Family No 2

6. $T_0 = 5.4\ hr.$

7. $T_p = 0.7(T_0) = 0.7(0.101) = 0.07\ hr.$

8. $\frac{T_0}{T_p} = \frac{5.4}{0.07} = 77$

8. $T_o/T_p = \frac{5.71}{0.07} = 80.4$

9. $\frac{T_o}{T_p}(Rev) = 75$

10. $T_p(Rev) = \frac{5.71}{75} = 0.076\ hr.$

11 $q_p = \frac{484A}{T_p} = \frac{484(0.261)}{0.076} = 1656\ ft^3/sec/in$

12 $Q_{qp} = Q \times q_p = 26(1656) = 43056\ ft^3/sec$

13. $Q_1 = 0.09(43056) = 3875\ ft^3/sec$

14 $V_1 = 53.3QA = 53.3(26)(0.261) = 361.7AF = 15.8 \times 10^6\ ft^3$

$V_{1max} = V_1 + V_e(\text{Lake \#2}) = (15.8 + 15.48)10^6 = 31.28 \times 10^6\ ft^3$

$V_e(\text{LAKE \#2}) = V_1 - V_{sp}$

$= 404.7 - 49.36$

$= 355.34\ AF$

$V_e = 15.48 \times 10^6\ ft^3$

15. $V_{uf} = 9.5 \times 10^6\ ft^3$

16 $V_{sp} = V_{ee} - V_{uf} = (11.4 - 9.5) \times 10^6 = 1.9 \times 10^6\ ft^3$

17 $V_{sp}/V_1 = 1.9/31.3 = 0.061$

B. $P = 12''$, $Q = 9.5''$

5 Family No 2

6. $T_o = 5.4\ hr.$

7. $T_p = 0.7(T_o) = 0.7(0.101) = 0.07\ hr.$

8. $\frac{T_o}{T_p} = \frac{5.4}{0.07} = 77$

9. $\frac{T_o}{T_p}(Rev) = 75$

10. $T_p(Rev) = \frac{5.4}{75} = 0.072\ hr.$

11. $q_p = \frac{484(0.261)}{0.072} = 1754.5\ ft^3/sec/in$

12 $Q_{qp} = 9.5(1754.5) = 16667.75\ ft^3/sec.$

13. $Q_1 = 16668(0.079) = 1316.8\ ft^3/sec.$

3/16/76

14 $V_1 = 53.3(9.5)(0.261) = 132\ AF = 5.8 \times 10^6\ ft^3$

-- $E_{NP} = 504 \quad E_{SW} = 505.5$

15 $V_{UF} = 9.5 \times 10^6\ ft^3$

16 $V_{SP} = V_{LO} - V_{UP} = (11.4 - 9.5)10^6 = 1.9 \times 10^6\ ft^3$

17 $\frac{V_{SP}}{V_1} = \frac{1.9}{10.05} = 0.189$

$V_1 = V_1(\text{O.H.}) + V_e(\text{SPRING})$
$= (5.8 + 4.25)10^6$
$= 10.05 \times 10^6\ ft^3$

$V_e = V_1 - V_{SP}$
$= (6.4 - 2.15)10^6\ ft^3$
$= 4.25 \times 10^6\ ft^3$

$Q_1 = Q_1(\text{OH}) + Q_e(\text{SPRING})$
$= 1317 + 425$
$= 1742\ \text{CFS}$

OLD HICKORY (LAKE No 3)

E_{sw} = 505.5'

3/16/76

ρ = 29.5"

Q_I = 6325

$\frac{V_{sp}}{V_I}$ = 0.061

1	2	3	4	5	6	7	8	9	10	11	12
E_w ft	V_{tw} AF	V_{sw} AF	V_{sw}/V_I	V'_{sw}/V_I	Q_o/Q_I	Q_o cfs	Q_e cfs	H_p ft	Q_e/b	b ft	V fps
[illegible]	[illegible]	[illegible]	[illegible]	0.34	0.52	[illegible]	[illegible]	[illegible]	27.1	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	0.3	0.59	[illegible]	[illegible]	4.5	[illegible]	137	
[illegible]	[illegible]	[illegible]	[illegible]	0.27	[illegible]	[illegible]	3975	4	[illegible]	[illegible]	
	[illegible]	[illegible]	[illegible]	6.25	[illegible]	[illegible]	[illegible]	3.5	17.2	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	6.23	0.71	[illegible]	4444	3	12.2	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	0.21	0.76	[illegible]	4760	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	5.1	[illegible]	0.19	0.79	[illegible]	4950	[illegible]	6.4	[illegible]	
[illegible]	[illegible]	2.1	[illegible]	0.16	0.97	[illegible]	5456	[illegible]	[illegible]	[illegible]	
[illegible]	13	[illegible]	[illegible]	0.14	0.9	[illegible]	5646	✓	[illegible]		
	13.1	[illegible]	[illegible]	0.11	0.97	[illegible]	6059	0.5	[illegible]		
[illegible]	[illegible]	5.6	[illegible]	0.58	0.22	383	3[illegible]	2.5	[illegible]	34	
[illegible]	[illegible]	5.1	[illegible]	0.53	0.26	453	406	2	[illegible]	71	
[illegible]	[illegible]	4.1	[illegible]	0.43	0.39	679	632	1.5	[illegible]	161	
[illegible]	[illegible]	3.5	[illegible]	0.37	0.5	871	825	1	[illegible]	425	
[illegible]	[illegible]	[illegible]	[illegible]	0.28	0.8	1394	1347	0.5	[illegible]	2403	
~~507.2~~								~~[illegible]~~	~~5.6~~	~~700~~	7
507.15							550		4.4	125	

Q = 1742

V_1 = 10.05

$\frac{1.9}{10.05}$ = 0.189

E_{sw} = 505.5

b = 125

ρ = 29.5"

Q_e = 3550

E_w = 510.1

ρ = 12"

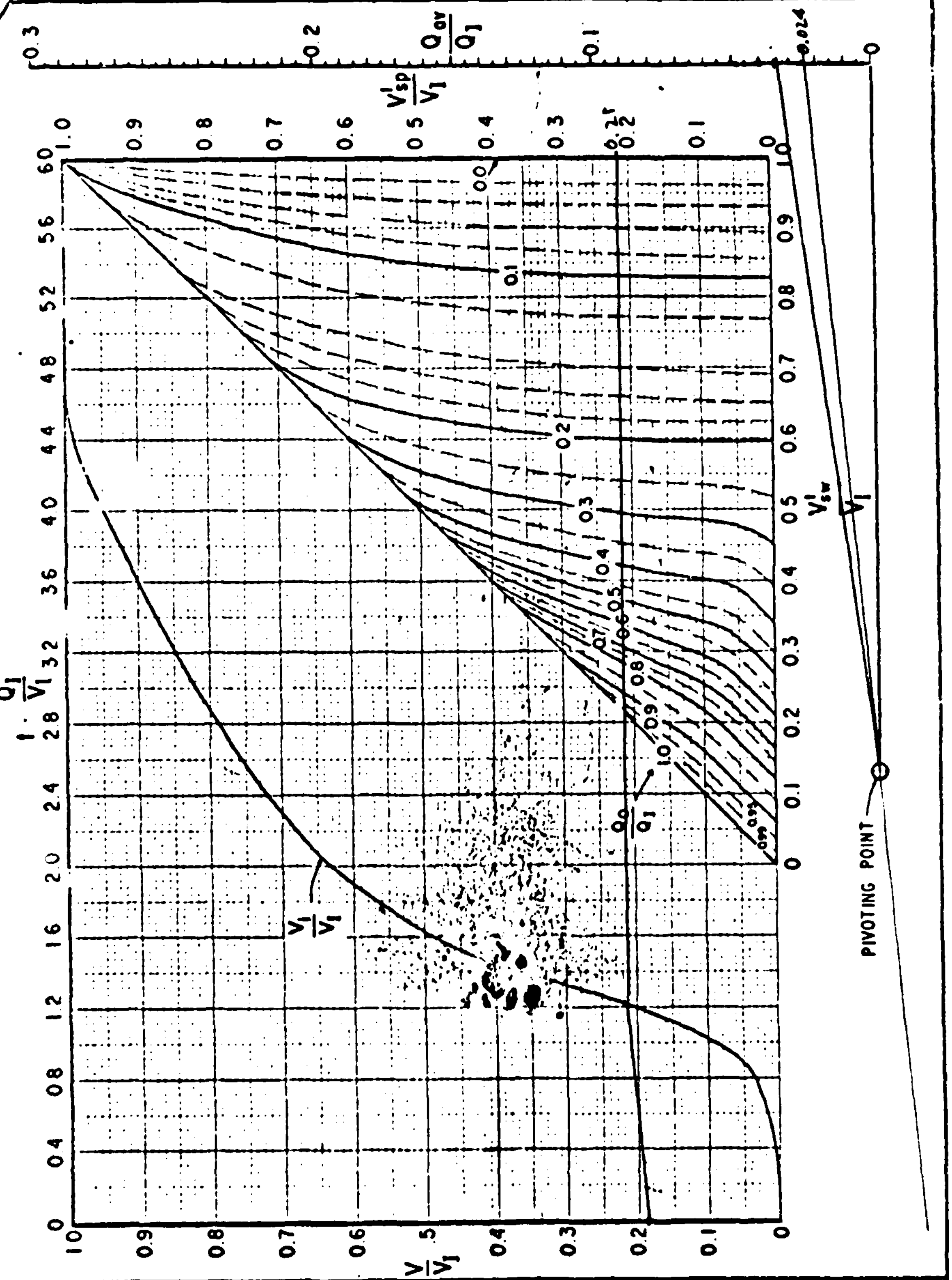
Q_e = ~~300~~ 550

E_w = ~~507.2~~ 507.15

V_e = ~~[illegible]~~

, 061

0.029



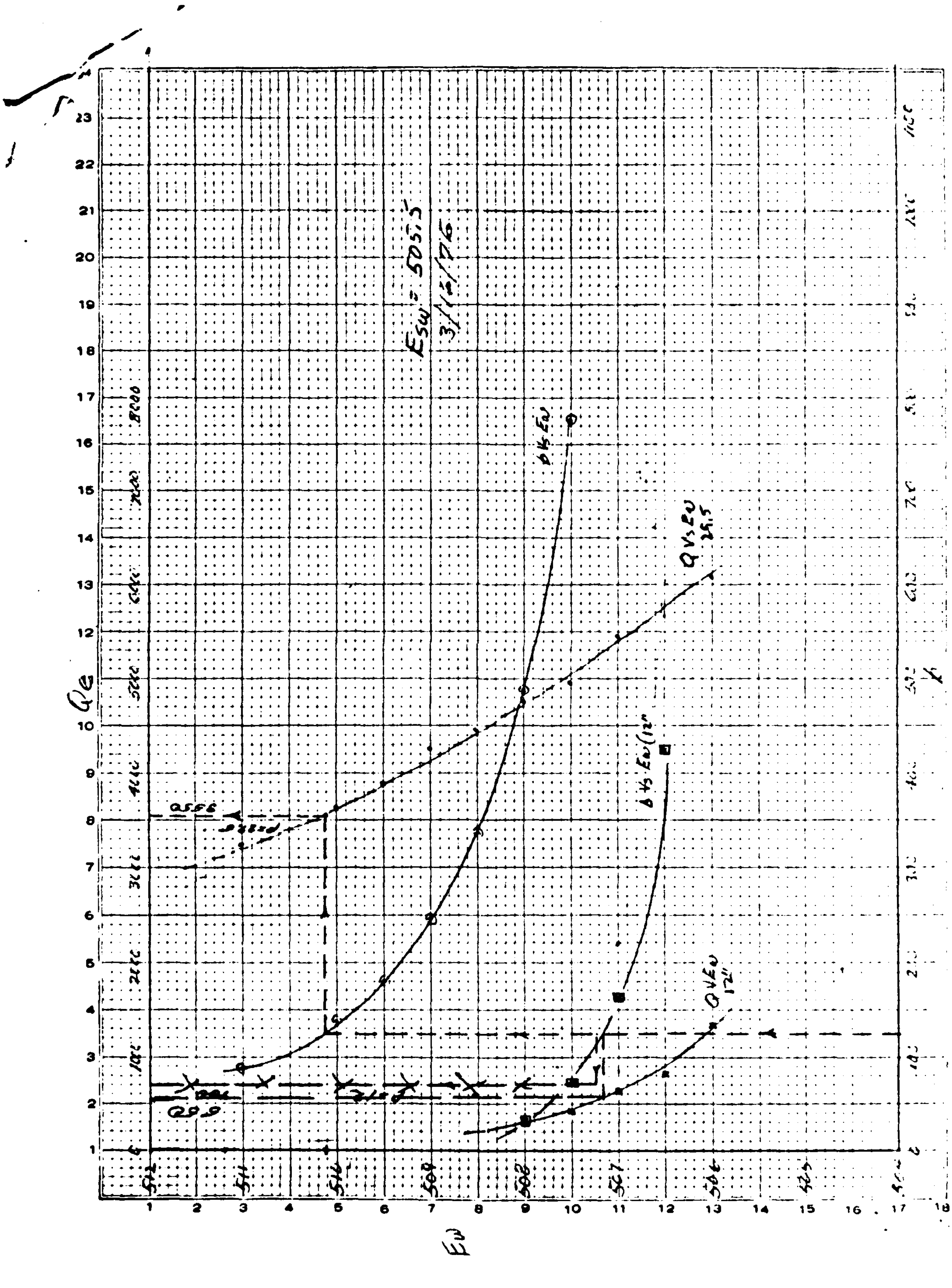
3/16/76

Esw = 505.5'

REFERENCE

U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Prepared By
REGIONAL TECHNICAL SERVICE CENTER
UPPER DARBY, PENNSYLVANIA

STANDARD DWG NO
ES-602
SHEET 12 OF 12
DATE November, 1965


$E_{SW} = 505.5$
3/12/76
Qe
Ew
Q vs Ew
25.5
Q vs Ew
12"
Q 5.56
Q 9.9

NON-FEDERAL DAM INSPECTION REVIEW BOARD
PO BOX 1070
NASHVILLE, TENNESSEE 37202

Commander, Nashville District
US Army, Corps of Engineers
PO Box 1070
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1. The Interagency Review Board, appointed by the Commander on 19 June 1981, presents the following recommendations after meeting on 9 July 1981 to consider the Phase I investigation report on Spring Lake Dam and Old Hickory Dam inspected by the Tennessee Department of Conservation.

2. The second paragraph of Section 3.2.1 of Old Hickory Dam should describe, in more detail, the muddy conditions that exist on the lower 1/2 to 2/3 of the downstream slope and the possible causes for this condition.

3. The first conclusion in Section 3.6.1 should be changed to include what the consequences will be to Old Hickory and Spring Lake Dams should Chancellor and Son Dam fail during the 1/2 PMF.

4. Some of the possible causes of the mud pockets should be included in the second conclusion of Section 3.6.1.

5. Under part a. of the recommendations, item 1 should indicate that the embankment soils are to be checked for dispersive properties.

6. Item 2 of part a. of the recommendations should be eliminated.

7. The condition classification for both dams should be changed from "significantly deficient" to "deficient."

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Alternate Chairman

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